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ORIGINAL MEMOIRS.

PARATHYROIDS AND THEIR SURGICAL RELATION TO GOITRE.*

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DURING the past several years the parathyroids have been studied by various methods, and, although our definite knowledge of their physiologic function and pathologic importance is limited, to-day we are justified in saying that these little glands are concerned in the metabolism of the body, and, consequently, that disturbances of them are of serious interest to both the internist and the surgeon. But, what seems to be the natural course in matters medical, the parathyroids, once recognized, became the object of numerous hypotheses. Theories have been advanced and diseases attributed to these structures without having the support of scientific investigation. Erroneous deductions have been made from defective experimentation, histologic conditions overlooked, and the findings misinterpreted. Illogical conclusions have been based on the administration of therapeutic agents, as, for example, the failure of parathyroid extract to control the attacks of

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tetany. However, recent and more exact methods of examination have dissipated many of those erroneous views and caused our minds to be focussed upon something definite.

There no longer seems to be substantial grounds for doubting the etiologic relationship between the parathyroids and one disease, namely tetany.

Experimental tetany has been produced in animals by the removal of parathyroidal tissue, and experimental tetany may be reckoned, in a certain sense, tetany following operation upon the human thyroid gland.

Histologic investigations of recent times have not only confirmed the results of experimental work, but also demonstrated that *spontaneous tetany* is caused by an *hypoplasia* with resultant *insufficiency* of the parathyroids. Therefore, in this paper we shall discuss these glands in their relation to the disease of tetany, but, before considering the *surgical* aspect of the subject, we shall briefly review some of the later works on the *spontaneous* form of this disease.

Tetany manifests itself by spasmodic attacks, which usually occur bilaterally, are often associated with intense pain, sometimes with slight œdema of the face, hands, and feet, and the latter have a tendency to assume a partial equinovarus position. In the *interval* between the attacks, the principal diagnostic points are *Trousseau's sign*, a peculiar tonic spasm of the fingers and thumb, the so-called *obstetric hand*, produced by prolonged, severe pressure upon the nerve-trunks, particularly the median nerve; *Chvostek's sign*, twitching of the facial muscles, elicited by tapping upon the trunk of the facial nerve, upon the malar bone, or over the infra-orbital foramen; *Erb's sign*, galvanic hyperirritability of the muscles, which contract to very weak currents; *Hoffman's sign*, extreme sensitiveness to the induced current.

Whereas *spontaneous* tetany is mostly observed in the child, yet attacks occur in adult life, and among these are cases of *tetania gravidarum*. Pathologic examinations seem to have proven that hemorrhages in the parathyroids have a positive significance in the causation of tetany, especially the

tetany of childhood, and that these hemorrhages produce their effect by injuring the parathyroidal tissue, inhibiting its development, and, consequently, decreasing its functional power. Haberfeld has recently reported six cases of undoubted *tetania infantum,* whose parathyroids showed hemorrhages, which manifested themselves partly as blood-cysts and partly as old hemorrhages with hæmatogenous pigment. It has not been possible to positively fix the exact time of the bleeding, but many points favor Erdheim's view, namely, that it takes place during labor. In support of this opinion are very young cases (four weeks, four months old), presenting *old* hemorrhages, and the fact that the parathyroids are not disposed to bleeding, so that the mechanism of labor with its associated trauma can very likely play an important part. The explanation has been advanced that in extreme flexion of the child's head the chin presses upon the region of the parathyroids, and thereby injury is produced.

In this connection another point of interest has been revealed. Several of Haberfeld's cases showed absence of valves in the veins of the affected parathyroids, while the valves were present in the glands which were intact. Therefore, deficiency of venous valves has also been considered by recent investigators as contributing to the occurrence of these hemorrhages, since it is maintained that in the presence of increased blood-pressure these valves are a safeguard against bleeding. It has been suggested that these hemorrhages in the parathyroids are the *effects* of the convulsive attacks and *not* the *cause* of the tetany. Cases have been reported in which autopsy revealed not only hemorrhages in these glands but also areas of recent bleeding in the pericardium and the pleuræ. However, special methods of examination positively proved that the hemorrhages in the parathyroids antedated the beginning of the convulsive seizures, consequently could not have been caused by them.

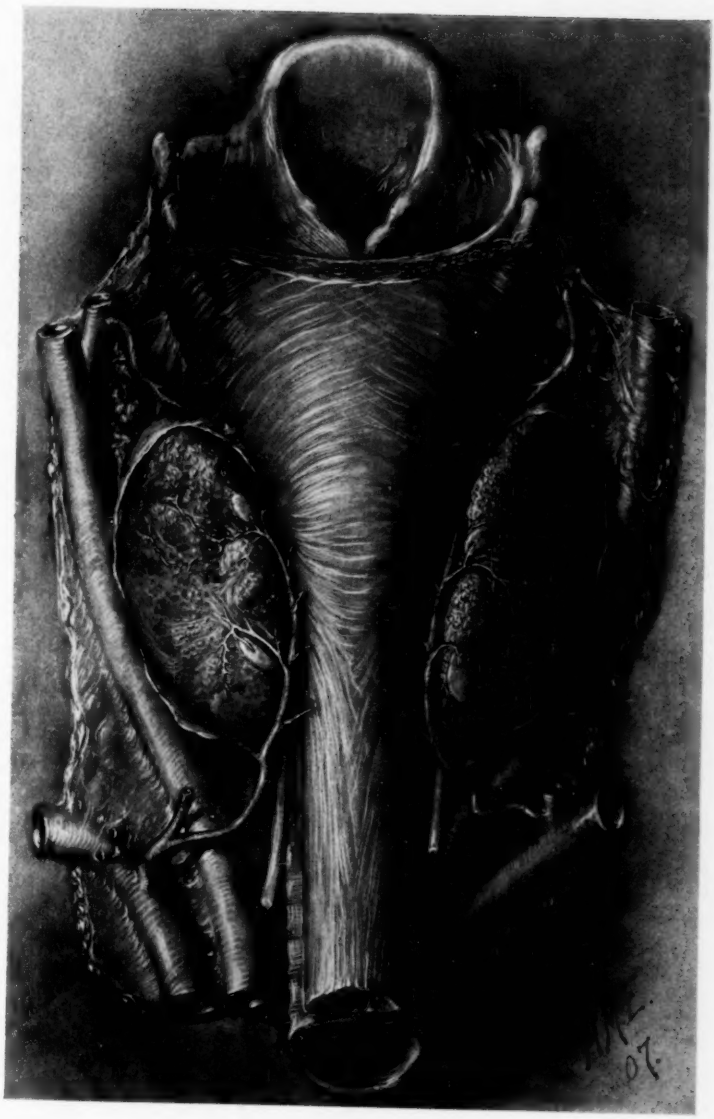
An objection that has been advanced against the hemorrhagic theory, and one that deserves discussion, is the fact that the attack of tetany does not occur at the time of bleeding,

but instead manifests itself very often only after the hemorrhages have been completely healed. That injury of the parathyroids takes place when the bleeding occurs is to be admitted, and that tetany does not appear simultaneously with the injury are facts which seem to be grounds for rejecting this theory. Escherich explains this apparent contradiction as follows: The central nervous system of the new-born is so insensitive that the clinical picture of tetany cannot manifest itself, and that such manifestation is only possible beginning with the third month. Escherich's view seems to be supported by the facts that the brain of the fœtus contains the highest amount of calcium (Quest), and that here calcium decreases with advancing age. Sabbatini has demonstrated that cerebral irritability is lowered by an increase of calcium and raised by withdrawal of the same. Therefore, it is concluded, tetany does not occur at the time of bleeding, because at this period the brain's irritability is very slight, which is due to the presence of a larger amount of calcium.

With regard to the importance of calcium in the condition of tetany, the writers refer to the observations of MacCallum and Voegtlin. These investigators have undertaken a study of the calcium metabolism of animals, in which this disease is produced by parathyroidectomy, and are endeavoring to demonstrate the relation of various salts, especially those of calcium, to experimental tetany. They state that all violent symptoms produced by parathyroidectomy—muscular twitching and rigidity, tachypnœa, fibrillary tremors, increased rapidity of the heart-beat, etc.—may be almost instantly cured by the intravenous injection of a solution of a calcium salt. The acetate or lactate in 5 per cent. solution is usually employed. Subcutaneous injection or the introduction of the solution into the stomach is quite as effective, but acts more slowly. The results from the use of magnesium are similar, but its otherwise bad effects contraindicate its employment.

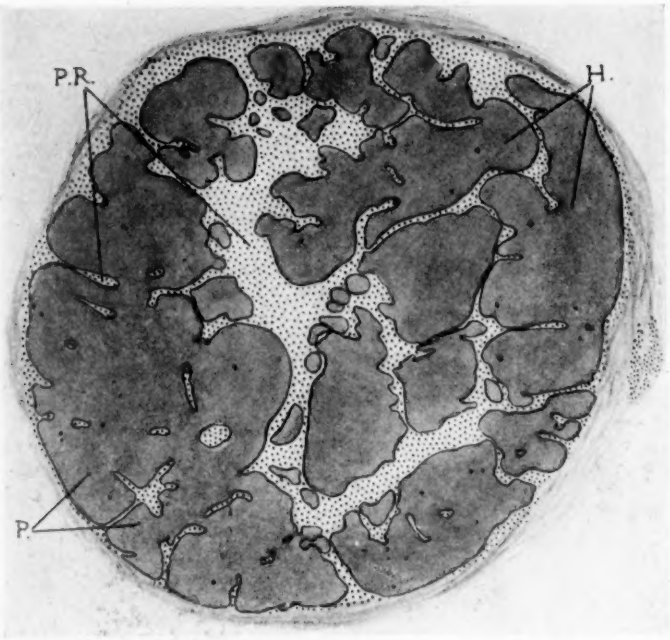
The condition of relief following the administration of these various salts lasts for perhaps 24 hours, when tetany

FIG. 1.



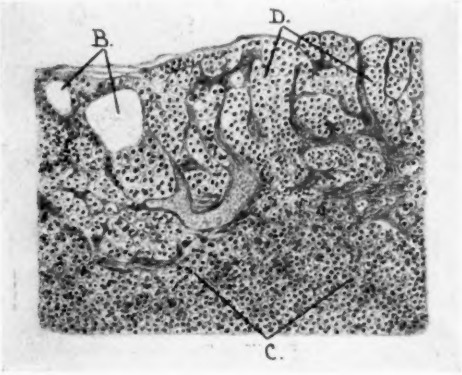
Parathyroid glandules.

FIG. 2.



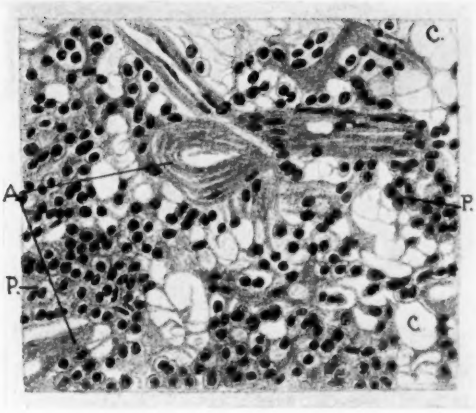
Cross-section through right superior parathyroid. Tetany, patient aged five months. Almost entire parathyroidal tissue destroyed by enormous hemorrhages. *H*, remains of parenchyma in the centre and as septa between the blood cysts, *P.R.* Many phagocytes (*P*) with pigment in the blood cysts, consequently signs of old hemorrhages. The zone of development completely absent. (After Haberfeld.)

FIG. 3.



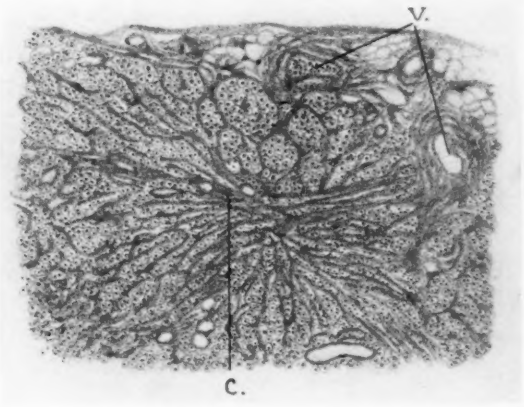
Small area of a parathyroid. Tetany, patient aged five months. *C*, small dark cells of the centre; *D*, zone of development showing large light cells which are absent at *B*, replaced by blood cysts (old hemorrhages). (After Haberfeld.)

FIG. 4.



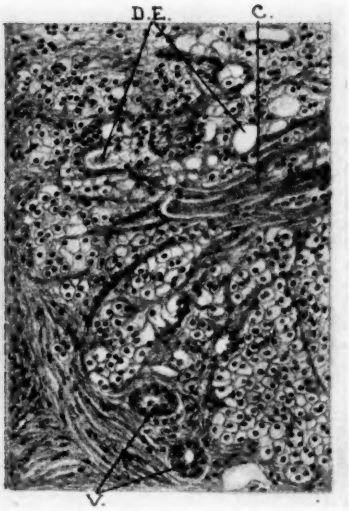
Tetany, patient aged 24 years. Amyloid degeneration of small vessels. *A*, cells near vessels show hydropsical degeneration, absence of nuclei, and swelling of protoplasm; *C*, loss of cell membrane with cavity formation; *P*, normal appearing parathyroidal cells. (After Haberfeld.)

FIG. 5.



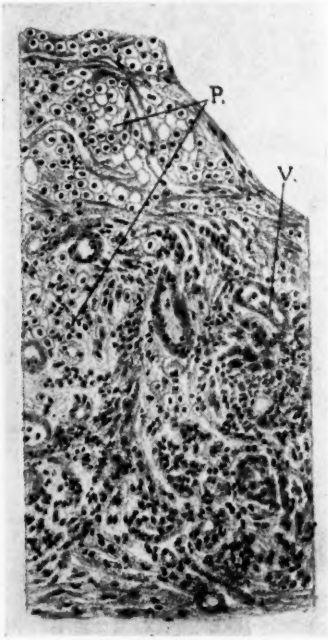
Tetania gravidarum. Patient aged 31 years. ×50. Area of a parathyroid showing moderately large, radiating cicatrix (*C*); vessels (*V*). (After Haberfeld.)

FIG. 6.



Same case as Fig. 5. × 125. Part of the cicatrix (*C*) is seen. Individual epithelial cells in this region swollen in place uniting and forming small cavities (*D.E.*). Vessels (*V*). (After Haberfeld.)

FIG. 7.



Same case as Figs. 5 and 6. × 160. Small area of a parathyroid which is almost completely atrophied. The section shows for the most part connective-tissue bands bearing many small vessels. Remains of original parenchyma (*P*); vessels (*V*). (After Haberfeld.)

may reappear. Analysis of the blood taken from a dog during tetany shows a calcium content which is only about half that of the normal dog on the same diet. These writers state that from their observations up to the present it is possible to construct at least a plausible, working hypothesis by which to explain their results. Apparently the parathyroids control in some way the calcium metabolism, so that upon their removal a rapid excretion, possibly associated with inadequate absorption and assimilation, deprives the tissues of calcium salts. In the case of tetany the central nervous system seems to be especially affected, as has been demonstrated by experiments in which muscles isolated from the central nervous system presented no twitching during the attacks.

However the salts of calcium and other salts may be concerned in maintaining a state of equilibrium in the function of the nervous system, and whatever may be the relation of the parathyroids to calcium and other metabolism, recent investigators state that all their experiences with tetany have shown that *insufficiency of these glands* is necessary for the production of tetany. This insufficiency occurs in experiments through removal of parathyroidal tissue; and in the *idiopathic tetany* of man it is caused by an hypoplasia of the parathyroids in consequence of pathologic processes.

In children there have been found hemorrhages, which, when they were relatively fresh and large (blood-cysts), presented evident severe injury of the parathyroids. But how is the insufficiency and therewith the tetany to be explained when even before the outbreak of the disease these blood-cysts have been gradually absorbed and only more or less blood pigment is to be found? As Erdheim has stated, by itself this pigment can scarcely produce injury of the parenchyma, but in spite of that fact it must be looked upon as the expression of a tissue injury which causes insufficiency of the parathyroids. Whereas it is not to be supposed that every hemorrhage in these glands produces hypoplasia, yet Yanase had never been able to demonstrate clinically normal galvanic irritability in any child whose parathyroids showed anatomically hemorrhages, even in slight amount.

Tetany is not to be explained alone by injury of parathyroidal tissue. There have been cases in which the glands were undoubtedly injured, that is, parathyroids disposed to tetany, but the attacks did not occur until another factor entered, for example, gastro-intestinal disease. Therefore, these patients lived for many years with defective parathyroidal tissue and were not seized with tetany until a contributing factor, whereby an excess of the toxic material was produced, caused hypofunction of the glands to be manifested. Beside the hypoplasia resulting from hemorrhages, other conditions have been noted in association with deficient development and insufficiency of the parathyroids. Haberfeld cites two cases of congenital syphilis, in which tetany developed and the parathyroids were shown histologically to be hypoplastic.

The same investigator was the first to examine the parathyroids in a case of tetany occurring in pregnancy. All four of the parathyroids showed pathologic changes, which included large scars, parenchymatous atrophy, and cysts. Therefore, basing their conclusions on experimental, clinical, and pathologico-anatomic investigations, recent writers state that the principal factor in the production of tetany is *insufficiency of the parathyroids.* This insufficiency may be either *absolute,* that is, referred alone to the glands, as by their absence (operative tetany), or relative, in which case the parathyroids are hypoplastic, consequently disposed to tetany, and hypofunction is precipitated by a contributing factor, as, for example, gastro-intestinal disease. The latter form seems from investigations to be the more frequent, and, for the tetany of children, is almost a law. Accordingly, injury of the parathyroids is to be regarded as disposing to tetany, while the releasing factor, whose nature still remains obscure, is undoubtedly of a very varying kind (infection, pregnancy, etc.). It is probable that the parathyroids, like other glands of the body, have factors of safety, which is somewhere between two and four times.

Surgical Importance of the Parathyroids.—Viewed in the light of all the experimental, clinical, and histologic works

which have been done, these glands are to be regarded as structures possessing a function that is essential at least for the normal metabolism of the body. Although the results of animal experimentation are not uniform with regard to some points, yet they have proven that removal of parathyroidal tissue is usually followed by a symptom complex, which is termed *experimental tetany.*

Histologic examinations have shown pathologic changes in the parathyroids of typical cases of spontaneous tetany, and that these changes represent a *hypoplasia,* deficient development of the glands, which disposes to insufficiency of function, and also that these structural defects seem at times to be the result of trauma. Consequently, guided by these scientifically supported facts, the surgeon should scrupulously guard against removal or injury of the parathyroids. Remembering their variable size, location, and appearance, the operator should preserve all small, especially gland-like masses about the capsule in case of operation on the thyroid gland. If such a mass be accidentally removed in the course of operation, it should at once be implanted beneath some part of the remaining capsule. Probably the greatest danger is in operating upon both lobes at the same time or the second lobe at a later period. Furthermore, it should be borne in mind that parathyroidal tissue is sometimes present within the thyroid gland. Although rare in the human, this important observation has been made by Müller, Getzowa, Michard, Kloeppel, and others, and is to be considered in the presence of tetany following removal of thyroidal tissue, where the normal location of the parathyroids had been easily avoided. Beside the variability of the parathyroids in size, appearance, and location, another point of interest is to be kept in mind, namely, the observations of Vincent and Jolly on the relationship between parathyroidal and thyroidal tissue. These investigators state that the thyroid and parathyroids are morphologically and functionally related; that the parathyroids left behind after thyroidectomy can, under conditions, develop in the direction of thyroidal tissue, and that a functional replacement also takes place.

Assuming that relationship to exist, it is conceivable that in some cases manifestations, which are the sequelæ of parathyroidal disturbance, may follow operations upon the thyroid gland. On the other hand, considering the generally unstable metabolic equilibrium and the associated psychic disturbances of many patients suffering with hyperthyroidism, we should not be at first too greatly concerned over a post-operative tetanoid attack, since it is intelligible that such manifestations might be precipitated by operative procedure. A few such cases have been observed and considered probably hysteroidal in nature.

Treatment.—No reliable treatment for tetany is at present known, but the experimental works of MacCallum and Voegtlin, together with the clinical and histologic observations of Erdheim, Strada, Yanase, Haberfeld and others suggest certain principles to be followed. According to these investigations deficient parathyroidal tissue is the principal causal factor in the condition, and there seems to be a disturbance at least of the calcium metabolism. Consequently, the ideal treatment would be to compensate for this glandular deficiency by transplanting parathyroids from other individuals, feeding with animal glands, the use of serum or the extract of parathyroidal tissue. Unfortunately none of these procedures has given dependable results. In order to restore the balance in calcium metabolism, calcium salts, acetate or lactate, should be administered either intravenously, subcutaneously, by stomach, or by rectal enemata, the strength of dose varying with the mode of administration.

In order to avoid those factors which contribute to the attacks of increasing the toxic metabolic product, the patient's general condition, especially the gastro-intestinal tract, should be given most careful attention, to show that such condition is relatively uncommon following operation.

In 3203 operations on the thyroid gland in St. Mary's Hospital, the total number up to December 1, 1911, but one patient is known by us to have manifested signs suggestive of tetany, yet when such signs do appear we cannot but feel that the condition is due to some error in operative technic.

CASE I.—G. H. S., female, aged forty-five years. Consultation Aug. 2, 1911. Clinical diagnosis, simple goitre. Family history, one sister had goitre. Personal history, two operations for lacerated perineum, last one eleven years ago. Sciatica, right leg, five years ago. Right lobe of thyroid gland enlarged for 25 years, left lobe for twelve years. Growing more rapidly the past three months, during which time the patient became nervous and suffered from dyspnœa. Rather despondent for last six months. No œdema. Able to do regular work up to present time. Operation, August 11, 1911 (St. Mary's Hospital), partial thyroidectomy, enucleation of cysts. Pathologic diagnosis, adenomata; cystic degeneration. Post-operative course: August 12, 1911, patient complained of stiffness in fingers and face, and tingling in legs. Fingers rigid and partially flexed at metacarpophalangeal joints, thumbs in palms; toes also flexed. August 13, 1911, patient complained of decided increase of symptoms. Treatment: 2.0 Gm. calcium lactate subcutaneously; thyroid extract, 0.30 Gm. every four hours for three doses; calcium lactate, 0.60 Gm. by mouth t.i.d. during the remaining time in hospital; trional, 0.60 Gm. at night. August 14, 1911, rigidity less and gradually diminished until the sixth day after operation, when it disappeared entirely. August 19, 1911, patient discharged from hospital.

It is questionable whether in this case genuine tetany was present, since some of the diagnostic points were wanting. The fact that symptoms subsided so soon after treatment might be suggestive, but a deduction from such unreliable premises would lead to error, especially since the signs did not reappear, and thyroid instead of parathyroid extract was used. Experimental evidence shows that, whereas tetany is relieved by the administration of calcium salts, yet the attacks tend to recur after 24 hours. Extract of thyroid gland was administered, but the indication for its employment is not supported by scientific investigation other than that the functions of the parathyroid and the thyroid seem to be interrelated. Even parathyroid extract has failed to produce effects in some cases of undoubted tetany (parathyroids removed at operation), although the treatment was continued for months.

Adhering closely to the view of parathyroidal causality in tetany, if the above was a genuine attack, either the parathyroids were already hypoplastic and rendered temporarily insufficient by the operative procedure and post-operative disturbances, or they were injured during operation, in which case an unusual location must be assumed, since only partial thyroidectomy and enucleation was performed on the thyroid gland of this patient. Finally, when the increasing nervous condition of the patient during the past several months is considered, the possibility of the manifestations having been hysteroidal in nature should be kept in mind.

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ARTERIOVENOUS ANASTOMOSIS—REVERSAL OF THE CIRCULATION—AS A PREVENTIVE OF GANGRENE OF THE EXTREMITIES.

REVIEW OF THE LITERATURE AND REPORT OF SIX ADDITIONAL CASES.

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A DISCUSSION has arisen of late between Coenen of Breslau and Wieting of Constantinople as to the efficacy of an arteriovenous anastomosis—reversal of the circulation—in preventing the spread of a real or threatened gangrene in the extremity of a human. Coenen claims that Carrel's statements and experiments in regard to the possibility of reversing the circulation in the limb of a dog are not conclusive. That, in fact, the valves of the veins do not give way as asserted and that as a result a true and complete reversal is never attained, the blood simply being shunted off to another vein and promptly returned to the heart without ever getting to the foot or hand. Furthermore, he asserts that the procedure is both anatomically and physiologically wrong, and he therefore warns against the indiscriminate performance of this operation.[1]

Wieting on the other hand says that his clinical work, which has been highly successful, speaks for itself.[2] He admits that there are several questions, such as the return of the blood to the heart, still unsettled, but believes they will be solved only through clinical experience, theories and experimental work not having given the required solution.

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[1] H. Coenen and Wiewiorowski: Ueber das Problem der Umkehr des Blutstromes und die Wietingsche Operation, Beit. z. klin. Chir., Aug., lxxv, Nos. 1–2, pp. 1–473, also Cent. f. Chir., No. 29, 1911.

[2] Wieting: Treatment of Angiosclerotic Gangrene by Diverting Arterial Blood into Venous System, Deut. Zeit. f. Chir., cx, Nos. 4–6, pp. 313–634.

In view of the increasing number of successful reversals, it would seem that Wieting's stand-point is deserving of some support. Indeed, it would be a sad state of affairs if, after all the brilliant experimental work done in the field of vascular surgery, we should still hesitate to attempt the practical application of our knowledge.

A careful search of the literature has revealed forty-six cases of arteriovenous anastomosis—reversal of the circulation—in the human, to which I wish to add the following six cases, two of which were done on the same individual, though at different times.

CASE I.—H. L., colored, male, age twenty-seven. (From the wards of Dr. W. S. Halsted, the Johns Hopkins Hospital.) This patient came in complaining of a growth in the right popliteal space. At operation, January 21, 1910, by Dr. Halsted, the growth was found to be a sarcoma originating in the popliteal nerve and involving the popliteal artery and vein. A defect of about four inches between the ends of the vessels remained after radical extirpation of the tumor. Believing then that the lower leg was in danger, I was graciously allowed to remove about five inches of the left saphenous vein and transplant it between the severed ends of the right popliteal artery and vein; in other words doing a typical reversal. (The distal end of the artery was so small that it was thought best to use the vein as its lumen more nearly corresponded in size with that of the saphenous transplant.) Following operation there was an œdema of the lower leg, a dilatation of the superficial veins, and an elevation of temperature in the right leg as compared to the left. The leg continued to have a good circulation, and the patient left the hospital in good shape and able to walk. He died 18 months after operation. No autopsy was obtained, as death occurred at his home, but the probabilities are that the growth returned.

According to E. Wolff,[3] out of thirty cases of popliteal aneurism, gangrene in various degrees occurred in fourteen

[3] Die Haufigkeit der Extremitatennekrose nach Unterbindung grosser Gefasstamme, Beit. z. klin. Chir., No. 58, 1908, p. 787–788.

following extirpation. It is necessary therefore to consider this a doubtful case, inasmuch as the chances were about even that the leg would have lived had no transplantation been done.

CASE II.—Miss M. G., white, age twenty-seven. Diagnosis Raynaud's disease. (Patient of Dr. J. C. Bloodgood, St. Agnes Hospital.) Five years ago the patient had a general infection from a wound on the index-finger. In May, 1910, she began to have pain in both feet, followed by some discoloration of the second toe of the right foot, necessitating removal of the toe. In January, 1911, two toes of her left foot became gangrenous and were removed. She constantly had pain in her legs, and her feet were always cold. On examination the pulse in the dorsalis pedis artery and the popliteal artery could not be felt in the left leg. The pain in this case was so severe and so constant that, believing the poor circulation had something to do with the condition, a reversal of the circulation in this leg was decided upon in the hope of giving relief. An end-to-end anastomosis between the femoral artery and vein in Scarpa's triangle was done on February 27, 1911. This being our first typical case, we made the mistake of cutting the vessels, vein, and artery at the same level and not allowing for the usual retraction following section of any vessel. It was not exactly a mistake either, because we started out to do a complete reversal, that is unite artery to vein and vein to artery, the latter to take care of the back flow. We did not know at that time, as we do now, that the complete reversal is all but impossible in the human without transplanting a piece of vein between one or the other of the vessels; nor did we know then, as we do now, that the complete reversal is unnecessary, because there are always enough veins in the limb to care for the back flow.

After trying for some time to bring the artery and vein together in spite of the retraction, we took about one inch off the upper end of the vein and transplanted it between the proximal end of the artery and the distal end of the vein, making a very satisfactory anastomosis. Following operation the pain gradually disappeared and now the left leg is apparently as good as it ever was. There is a powerful thrill to be felt and auscultated over the site of anastomosis and extending down to the knee.

For a time following this operation, strange to say, the patient obtained considerable relief in her right leg, and the dorsalis pedis and popliteal pulse, previously absent, could be obtained again. Gradually, however, the old pain recurred, the pulse was lost, and the foot began to get discolored in patches. The sciatic nerve was stretched, but only seemed to aggravate matters, in addition to giving the patient a foot-drop.

CASE V.—On May 27, 1911, therefore (10 days after stretching the sciatic nerve), a lateral anastomosis between the femoral artery and vein of the right leg according to the method of Bernheim and Stone,[4] was done, the vessels being exposed and sutured in Scarpa's triangle. The vein was tied off proximal to the site of suture to prevent back flow to the heart, but the artery was left intact. We considered this an improvement over the old end-to-end anastomosis, because it did not disturb the arterial circulation at all, but simply gave an added channel of arterial blood by means of the vein. The anastomosis has been perfectly satisfactory, as is evidenced by the thrill and pulsation over the site of anastomosis and the splendid circulation of the foot.

At this date, 11 months after the first and 7 months after the second operation, the left leg has a circulation apparently as good as normal and gives no pain. The right leg also has an apparently normal circulation, but there is still a foot-drop, anæsthesia of the muscles of the lower leg, and pain along the course of the sciatic nerve. This condition is slowly improving, and strong hopes of a complete recovery are held out by the neurologists.

CASE III.—M. R., white, male, age forty. (Patient of Dr. J. C. Bloodgood. St. Agnes Hospital.) Patient had been a sufferer from Raynaud's disease for nearly five years, having suffered extreme pain at times in all his extremities. The circulation in his right toes was very poor, and they became gangrenous, one by one, until all but the big toe had to be removed. He seemed to get along fairly well as regards his left foot, until March, 1911, when he came in with beginning moist gangrene of all the toes of this foot. The arterial tension was not increased. The urine was negative; the Wassermann was negative.

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[4] ANNALS OF SURGERY, October, 1911.

The usual remedies failed to check the gangrene or to relieve the pain, so it was decided to reverse the circulation in the limb as a last resort. The operation was done March 27, 1911, an end-to-end anastomosis being done between the femoral artery and vein in Scarpa's triangle. The artery seemed smaller than normal, even when distended with blood, and the fibrous sheath as well as the adventitia was more adherent and perhaps a little more dense than usual. The calibre of the vein was smaller than usual, though in other respects it seemed normal.

On the day following operation, the leg was quite œdematous, all the superficial veins were dilated, a popliteal pulse could be felt (it was absent before operation), and the patient seemed to have less pain, although the condition of the foot had changed little, if at all. After this, the pain gradually became worse and the gangrene progressed, so that three days after operation the leg was amputated at the thigh. At this operation the site of the blood-vessel anastomosis was exposed and found to be working beautifully.

Looking backward, it would seem that this case was badly selected and the blood-vessel operation ought never to have been done, because apparently the gangrenous process had progressed so far that the nerves had become involved as well as the smaller vessels, thus making an attempt at saving the limb utterly hopeless.

Case IV.—M. B., white, female, age sixty-one. (Patient of Dr. J. C. Bloodgood, St. Agnes Hospital.) This patient came in complaining of sharp pains and an extensive ulcer of her right foot, which had been present for about two and a half months. There was tingling and numbness, the skin was white and cold, and there were dark brown areas of gangrene from the toes to the ankle. The patient had a general arteriosclerosis, there was no sugar in the urine.

On March 27, 1911, the femoral artery and vein were exposed in Scarpa's triangle; on severing the artery preparatory to doing an end-to-end anastomosis, the vessel was found to be two-thirds occluded by an old thrombus; the vessel wall was quite thick and sclerotic. Although the outlook under such circumstances was very discouraging, the thrombus was pressed out of the vessel with the thumb and fore-finger and the usual

end-to-end anastomosis done. The blood went over in the usual manner and continued to do so as long as the vessels were exposed. Following operation, although no pulse could be felt over the site of anastomosis and no thrill could be elicited by the stethoscope, the condition of the patient's foot gradually became better and the ulcers healed. Just before the patient left the hospital a faint pulse could be felt in the femoral vein below the site of anastomosis. The success of this case from an operative stand-point is naturally doubtful, but the circulation in the patient's foot and leg was so poor before operation that it seems that had the anastomosis been a complete failure, the foot must surely have become gangrenous.

CASE VI.—W. L. B., white, male, age fifty-two. (Patient of Dr. J. M. T. Finney, at the Union Protestant Infirmary.) For about two years the patient had been suffering with severe pain in his left hand and arm, the fingers at times becoming quite cyanosed. He had had the tips of three fingers of this hand amputated because of gangrene. The other extremities were involved in a similar manner, but to a lesser degree, although the pain was so severe that the patient had become addicted to morphine. The patient had had a suspicious venereal sore and had been a heavy drinker; he had also had at one time, in 1900, a severe case of dysentery. There was a generalized arteriosclerosis; the urine was negative, the Wassermann was negative; no radial pulse was to be felt in the left wrist.

Under expectant treatment the patient improved for a time, but later on the condition in the left hand became so threatening that a reversal of the circulation in the upper arm was done in the hope of avoiding amputation. The operation was done on June 7, 1911. It had been our intention to do a lateral anastomosis, but on exposing the vessels the artery was found almost completely occluded by an organized thrombus. We therefore went above this thrombus and did an end-to-end anastomosis between artery and vein at the lower limit of the axilla. Following operation the patient's pain was completely relieved, the color in the arm and hand became far better than before operation, and motion in the fingers was considerably improved. No pulse, however, could be felt below the site of

anastomosis, and the success of this operation from an operative stand-point is also in doubt. It is fair to state, however, that the vein branched immediately below the suture line and thus divided up the pulse considerably. In addition to this, the patient left the hospital in such good condition that it seems as if some blood must have been going down to the hand through the venous channels, otherwise gangrene must have ensued.

A list, then, of all the cases in the literature, including my own, will be as follows:

CASES OF ARTERIOVENOUS ANASTOMOSIS REPORTED IN LITERATURE.

Case 1.—San Martin y. Satrustegui: Male, 52; situation leg, for gangrene of foot; lateral anastomosis. Failure; amputation 6 days post-operation, death 13 days post-operation.

Case 2.—San Martin y. Satrustegui: Male, 75; situation leg, for gangrene of foot; lateral anastomosis. Patient recovered, although before operation gangrenous part removed. Case negative.

Case 3.—Jaboulay: Male, 47; situation leg, for beginning gangrene; lateral anastomosis. Failure.

Case 4.—Jaboulay: Male, 67; situation leg, for threatened gangrene. Failure; amputation 4 days post-operation, death 6 days post-operation.

Case 5.—J. C. Hubbard: Male, 80; situation right leg, for beginning gangrene; artery invaginated into vein. Unimproved; amputation.

Case 6.—H. Lilienthal: Male, 20; situation left leg, for beginning gangrene; end-to-end. Death 31 hours after operation, shock.

Case 7.—C. A. Ballance: Female, 75; situation right leg, for beginning gangrene. Successful; patient died 5 months after operation of gangrene of the large intestine. No autopsy.

Case 8.—Wieting: Male, 40; situation left leg, for threatened gangrene; intubation. Successful; patient discharged after 2 months, well.

Case 9.—Orhan: situation leg, for beginning gangrene; intubation of popliteal artery and vein. Failure; amputation.

Case 10.—J. C. Hubbard: Female, 60; situation leg, for beginning gangrene; artery invaginated into vein. Failure; amputation.

Case 11.—F. B. Lund: Male, 32; situation left leg, for threatened gangrene; end-to-end. Failure; amputation.

Case 12.—J. C. Hubbard: Female, 84; situation left leg, for beginning gangrene; end-to-end. Failure; death from senility 2 months after operation.

Case 13.—D. J. Armour and E. A. Smith: Male, 69; situation right leg, for threatened gangrene; end-to-end. Failure; amputation 2 weeks post-operation.

Case 14.—J. C. Hubbard: Male, colored, 77; situation right leg, for beginning gangrene; end-to-end. Temporarily successful; amputation 5 weeks post-operation because of pain and œdema.

Case 15.—G. P. Muller: Male, 51; situation left leg, for beginning gangrene; end-to-end. Failure.

Case 16.—Bier: Male, 38; situation leg, for beginning gangrene; intubation. Failure; amputation.

Case 17.—Payr: Male, 70; situation leg, for beginning gangrene; intubation; profunda artery intubated into femoral vein. Failure; death 16 days post-operation.

Case 18.—Abalos: Male, 62; situation right leg, for beginning gangrene; lateral anastomosis femoral artery and saphenous vein. Failure; amputation.

Case 19.—Imbert: Male, situation leg, for gangrene; lateral anastomosis, femoral artery and saphenous vein. Failure; death 2 days post-operation.

Case 20.—Celesia: Female, 52; situation leg, for gangrene; lateral anastomosis, femoral artery and vein. Failure; death 20 days.

Case 21.—Goldberg: Male, 64; situation leg, for gangrene; intubation. Successful, but death 15 days post-operation from erysipelas.

Case 22.—Jaboulay: Male, 66; situation leg, for gangrene; end-to-end. Failure; amputation.

Case 23.—Tuffier: Male, 50; situation leg, for threatened gangrene; end-to-end. Successful.

Case 24.—Imbert: Male, 25; situation leg, for popliteal artery and vein ruptured by lightning stroke; end-to-end anastomosis of popliteal artery and vein. Failure; amputation.

Case 25.—Tuffier: Male, 56; situation left leg, for beginning gangrene; lateral anastomosis. Failure; death.

Case 26.—Doberauer: Male; situation arm, for thrombus and threatened gangrene; invagination. Successful.

Case 27.—Tuffier: Male, 50; situation leg, for beginning gangrene; end-to-end. Successful.

Case 28.—Lacroix: Male, 25; situation leg, for gun-shot wound; end-to-end. Failure; amputation.

Case 29.—Schmeiden: Female, 48; left leg, for gangrene; end-to-end. Death 24 hours post-operation.

Case 30.—Enderlen: Situation leg, for threatened gangrene; end-to-end. Failure; amputation.

Case 31.—Enderlen: situation leg, for beginning gangrene; end-to-end. Death 3 days post-operation.

Case 32.—Goyannes: situation leg, for aneurism; end-to-end. Successful.

Case 33.—Kruger: Female, 48; situation right leg, for beginning gangrene; intubation. Failure; amputation.

Case 34.—Tietze: Female, 69; situation leg, for gangrene; intubation. Failure; death 19 days post-operation.

Case 35.—Tietze: Male, 64; situation right leg, for gangrene; intubation. Successful, but death from erysipelas 15 days post-operation.

Case 36.—Payr: Male, 70; situation leg, for beginning gangrene; profunda artery intubated into femoral vein. Failure; death 16 days post-operation.

Case 37.—C. Beck: Male, colored; situation right leg, for gangrene; lateral anastomosis. Failure; amputation.

Case 38.—Wieting: Male, 40; situation right leg, for threatened gangrene; lateral anastomosis. Successful.

Case 39.—Orhan: Male, 40; situation left leg, for gangrene; intubation. Failure: amputation.

Case 40.—Wieting: Male, 33; situation left leg, for beginning gangrene; lateral anastomosis. Temporarily successful; amputation 3 months post-operation.

Case 41.—Wieting: Male, 35; situation right leg, for threatened gangrene; intubation. Successful; although half of foot had to be amputated.

Case 42.—Wieting: Male, 32; situation left leg, for threatened gangrene; lateral anastomosis. Successful.

Case 43.—E. Heymann: Male, 47; situation left arm, for beginning gangrene; end-to-end. Successful; patient well 11 months post-operation.

Case 44.—Quenu: Male, 48; situation left leg, for Raynaud's disease; end-to-end. Temporarily successful; amputation 4 months post-operation.

Case 45.—Coenen: Male, 51; situation right leg, for beginning gangrene; end-to-end. Failure; amputation 4 days post-operation.

Case 46.—Glasstein: Male, 38; situation right leg, for threatened gangrene; end-to-end. Successful.

Case 47.—B. M. Bernheim: Male, colored, 27; situation right leg, for sarcoma of popliteal space necessitating resection of popliteal vessels; end-to-end. Doubtful; death from metastases 18 months post-operation.

Case 48.—B. M. Bernheim: Female, 27; situation left leg, for Raynaud's disease; end-to-end. Successful.

Case 49.—B. M. Bernheim: Female, 27; situation right leg, for Raynaud's disease; lateral anastomosis. Successful.

Case 50.—B. M. Bernheim: Female, 61; situation right leg, for beginning gangrene; end-to-end. Successful.

Case 51.—B. M. Bernheim: Male, 40; situation right leg, for Raynaud's disease; end-to-end. Failure; amputation 3 days post-operation.

Case 52.—B. M. Bernheim: Male, 52; situation left arm, for threatened gangrene; end-to-end. Successful.

In studying these 52 cases I find that 38 were done on males, 10 on females, and in 4 the sex was not stated. The ages varied all the way from 20 to 80 years. Fifteen out of the 52 cases must be considered successful ones, that is, cases in which the reversal, as far as one can judge, actually saved the limb from real or threatened gangrene—a percentage of 30 per cent. I have included Case 7 among the successes, because death was in no way related to the vascular condition in

the leg, but I have thrown out Cases 14, 40, and 44 because, though apparently successful as far as the actual operation was concerned, an amputation later on became necessary. Case 47, as said above, I consider doubtful, and Case 2 negative.

Among the failures there were 13 deaths; 2 from shock and 11 from senility and erysipelas. Most of these patients were in a desperate condition physically at the time of operation, thus rendering an operative procedure precarious to say the least.[5] It is difficult to see how the operation of reversal of the circulation could have contributed any more to the cause of death than any other operative procedure that may have been performed on the limbs of the same individuals. Just why there should have been so many cases of erysipelas is a mystery to me, unless it can be laid to the door of faulty technic. It has not occurred in my own series of cases.[6]

In the remaining 22 cases the course of disease was uninfluenced by the reversal, although there was a temporary improvement in several cases. Amputation was performed in each instance.

The operation was done twice in the upper extremity, once for thrombus and threatened gangrene, once for threatened gangrene, both times successfully. The remaining cases were in the leg, the operation being done four times for Raynaud's disease, once for sarcoma of the popliteal space, which necessitated removal of about four inches of the popliteal artery and vein, once for aneurism, once for rupture of the popliteal artery and vein, once for gun-shot wound, and the remainder for real or threatened gangrene.

As to methods of operation, the end-to-end suture of Carrel and Stich was done 23 times with 8 successes, lateral anastomosis 12 times with 4 successes, invagination (end of artery into end of vein) twice with 1 success, and the intuba-

[5] In a personal communication to Coenen, Gottstein said that he had done three cases of reversal, with death in each case.

[6] It is interesting to note that in the last 16 cases there have been no deaths, and that of these cases 9 were successful, 5 unsuccessful, and 1 doubtful.

tion of Wieting (end of artery into side of vein) 9 times with 2 successes. The method was not stated twice and one of these operations was successful.

I believe, and Wieting also seems to lean toward a similar belief, that in the future the method of choice for reversal will be a lateral antastomosis, and in conjunction with Stone [7] have advocated a method whereby the artery and vein are incised transversely through one-third of their diameter and then sutured. Following the suture and before turning on the blood stream, the vein is tied off proximal to the site of anastomosis to prevent back flow to the heart. The flow through the artery is not interfered with whatsoever, the only thing that happens being an added arterial channel through the vein. In this way the artery will continue to carry nourishment as far as it is patent, while the vein will supposedly carry it to the foot or hand. Should a thrombus occur at the site of anastomosis, it will form in the side of the artery (as we have proved experimentally) and the limb will be no worse off than before. On the other hand, in the event of success, the limb will have an abundant supply of blood. I have so far done this operation once clinically (Case 49), and have been very much gratified at its success. Wieting did a somewhat similar operation in Cases 38, 40, and 42, the first and last being successful.

Just how far down the vein the blood will go is a question that can be decided only by clinical cases. That the arterial pressure will force the blood beyond the valves of the femoral vein in a dog I have demonstrated experimentally, as well as Carrel, and I am firmly convinced that a similar phenomenon takes place in the human. To say that Wiewieorowski was unable to inject the veins of a cadaver from above and that, therefore, a reversal of the circulation in a limb is impossible, shows a lack of understanding of conditions as they are in the living.[8] The constant pounding of the arterial blood

[7] ANNALS OF SURGERY, October, 1911.

[8] Coenen and Wiewieorowski have only done one case in the human and that was unsuccessful.

against the valves of the vein gradually wears them down and forces them to give in the dog; why cannot a similar condition take place in the human? I believe it does, just as the constant pounding of the surf wears down the hardest rock, just as the fearful pounding of a thoracic aneurism at times slowly but surely wears away a man's vertebræ.

But as Wieting says, success is the best of all refutations, and as time goes on the successful cases will increase in number. In the past, the cases have not been selected with sufficient care. It is obviously impossible to bring the dead back to life, yet that has all but been attempted. Around every fulminating gangrenous area the neighboring vessels, veins as well as arteries, are partially or wholly thrombosed. If this condition prevails only to a slight degree, well and good, but if it is extensive, if all the toes, or half the foot, or all the foot is involved, to do a reversal is only inviting failure. The cases must be gotten before the gangrene arises. If this is impossible, it is best to let the process subside or localize and then do a reversal in the hope of preventing further encroachments. The age of the patient has little or nothing to do with the question, but rather the age and condition of his vessels.

Another most important factor to be considered is the skill and experience of the operator. It is my belief that the frequent failure following reversal of the circulation in the past has been due not so much to the failure of the valves of the veins to give way as to a thrombus at the site of anastomosis—in other words, to a faulty technic in the suture. Animal experimentation and lots of it is an absolute necessity to the surgeon who wishes to do clinical work in the field of vascular surgery. Too much stress cannot be laid upon this point, and a more general observance of it can but bring better results.

It is indeed a great pleasure to be able to acknowledge my indebtedness to Dr. W. S. Halsted, Dr. J. M. T. Finney, Dr. J. C. Bloodgood, and Dr. Harvey Cushing. Without their aid and kindly sympathy neither the experimental nor the clinical work which forms the basis of this paper could have been accomplished.

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NOTES ON THE TECHNIC OF SUTURING BLOOD-VESSELS WITH A NEW INSTRUMENT.*

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THE history of successful blood-vessel suturing goes back only a few years. In no department of surgery is success so dependent upon an accurate following of technical detail. The slightest break in asepsis, any undue roughness in handling the vessels, or the lack of mechanical accuracy means either immediate failure or else clotting and obstruction of the lumen of the vessel soon after the operation has been completed. The development of this distinctive branch of surgery has been fully described by Watts,[1] and more recently by Ehrenfried and Boothby,[2] and Winthrop.[3] Carrel's work in demonstrating, in 1902, the essential features in suturing blood-vessels is the real beginning of successful surgery in this field. He showed that strict asepsis, the utmost gentleness in handling the vascular endothelium, and accurate approximation of intima to intima are prime factors in suturing blood-vessels. He called attention to the fact that, aside from immediate failure, remote clotting was due to some technical error, as wherever the endothelial cells of the intima are injured, either by trauma or by drying, clots sooner or later are very likely to occur.

It is the general opinion among surgeons that the suturing of blood-vessels is exceedingly delicate and may be done only by a favored few. In this way its usefulness has been curtailed, for emergency surgery, such as stab and bullet wounds of the vessels, furnishes the most fertile clinical field for this work, and those who do much emergency surgery are

* Read by title at a meeting of the Southern Surgical and Gynæcological Association, Washington, D. C., Dec. 12, 13, and 14, 1911.

[1] Bulletin of Johns Hopkins Hospital, 1907, vol. xviii.

[2] ANNALS OF SURGERY, Oct., 1911, 485.

[3] Southern Medical Journal, Nov., 1911, 760.

the very men who should be competent to suture blood-vessels. Any effort to simplify the technic should therefore increase the clinical usefulness of this procedure. In experimental work, after the general principles are mastered, such as placing the sutures and careful handling of the intima, the most prominent difficulty is managing the guy sutures. The necessity for changing hands and transferring guy sutures after suturing each third of the vessel, the chances of their being tangled, the maintenance of proper tension on the guy sutures, and the relaxation of the tension while changing from one-third of the vessel to the other, are likely to be confusing and to make the sutures irregular and faulty. Another very practical objection is the difficulty in obtaining the services of an assistant trained in this work at just the time when such help is most needed.

In order to avoid these difficulties and in an effort to simplify the technic, I have used an instrument for holding the guy sutures in position. This instrument (Fig. 1) consists of a small steel shaft about one-sixteenth of an inch in diameter, which curves at one extremity into a shorter shaft. The long shaft or handle is six inches long, and the short shaft is one and three-quarter inches long. The short shaft is placed at an angle of 55 degrees to the long shaft. The curved portion is flattened out quite thin so as to form a light spring. There are five buttons, one on the main shaft as close as possible to the curve, one at the extremity of the short shaft, one a half inch below this, and two on the main shaft at points about opposite the buttons on the short shaft. All of these buttons hug the instrument closely and are so constructed that the guy sutures are held securely by merely wrapping them twice around the buttons.

The technic of suturing blood-vessels with the use of this instrument is as follows:

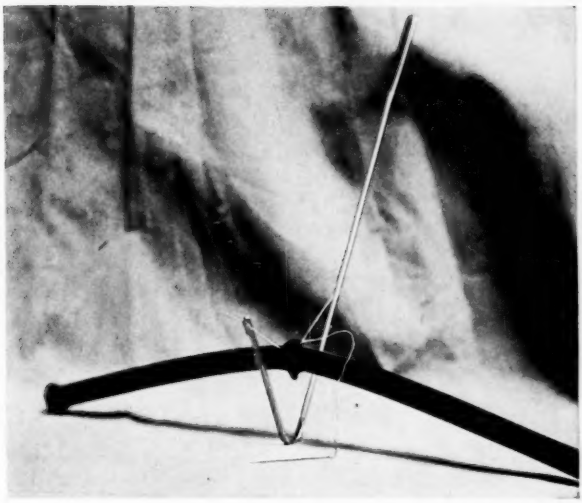
The vessel is exposed and clamped on each side of the operative field with rubber covered Crile clamps. It is divided with sharp scissors, and the adventitia is pulled down over each end of the vessel between the finger and thumb and cut squarely off.

The ends are washed out with salt solution in a medicine dropper. The ends of the vessel are then smeared with warm vaseline and three guy sutures are placed with a No. 16 straight needle and fine black silk. I untwist No. 1 black Chinese twisted silk into three strands and use these for sutures. After threading, the strand is secured in the needle by a single knot. The thread must be thoroughly anointed with vaseline before being used or may be boiled in vaseline. Three guy sutures divide the vessel's circumference into three equal parts and are passed by going from without inward near the end of the vessel, the point of the needle emerging from the intima. The needle is then carried to the other end of the vessel, which it penetrates in a reverse direction, that is, from within out, entering on the intima. These guy sutures are tied as they are inserted, using the ordinary knot. The ends of the suture are held taut while running down the second turn of the knot so as to prevent the first turn from slipping. The instrument above described is then placed under the artery with the short shaft toward the operator, and the bottom guy suture is wrapped twice around the lowest button on the main shaft. The ends of the suture are then cut close to the button so as to be rid of unnecessary thread. The upper guy suture nearest the main shaft is fastened by taking the end of the suture without the needle (the short end of the suture) and wrapping it around one of the two upper buttons on the main shaft. In vessels of ordinary size the lower of these two buttons is used. The end of this suture that is threaded is not cut, but is left for future suturing. The third guy suture is wrapped twice around one of the buttons on the short shaft while this shaft is very slightly pressed toward the main shaft. When this pressure is released, tension is placed on the three guy sutures, and the circumference of the blood-vessel is pulled from a circle into a triangle and held rigidly in this position (Fig. 2). The suturing begins at the upper guy suture on the main shaft, that is, the upper guy suture farthest from the operator. The instrument is held with the handle vertical, and the long end of this guy suture, which has been left with the needle attached, is passed back and forth through the slightly everted lips of the upper third of the margins of the artery, after the manner of a continuous mattress suture (Fig. 3). The instrument is slightly elevated during this suturing, which still

FIG. 1.

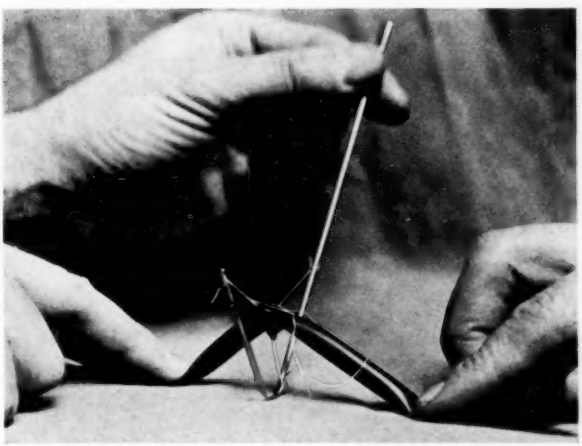
The instrument for holding the guy sutures, as described in the text.

FIG. 2.



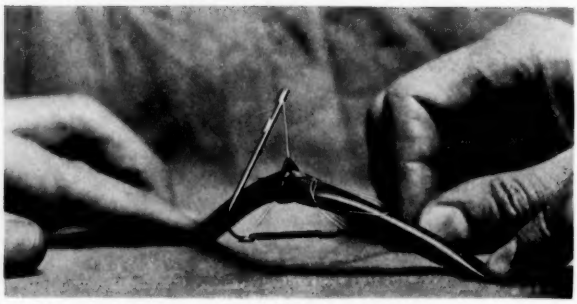
A thin rubber tube representing an artery with the three guy sutures placed and fastened to the buttons on the instrument. The circumference of the tube is made triangular by the tension of the guy sutures.

FIG. 3.



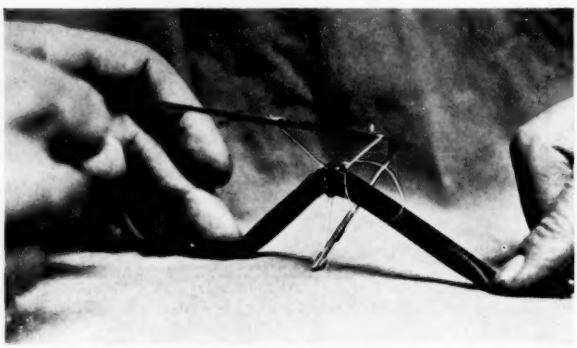
The handle of the instrument is upright and the continuous mattress suture has been started.

FIG. 4.



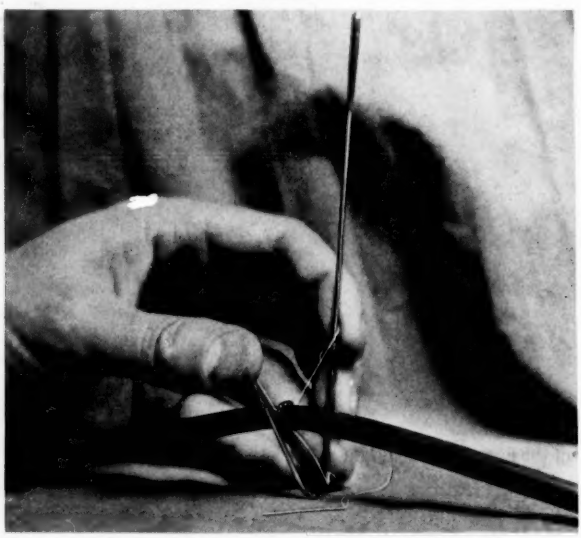
The handle is depressed till it is horizontal and points away from the operator. The second division is being sutured.

FIG. 5.



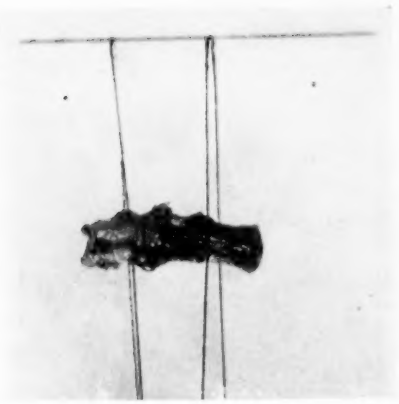
The handle of the instrument is depressed till it is horizontal—this time pointing toward the operator. The last division is being sutured.

FIG. 6.



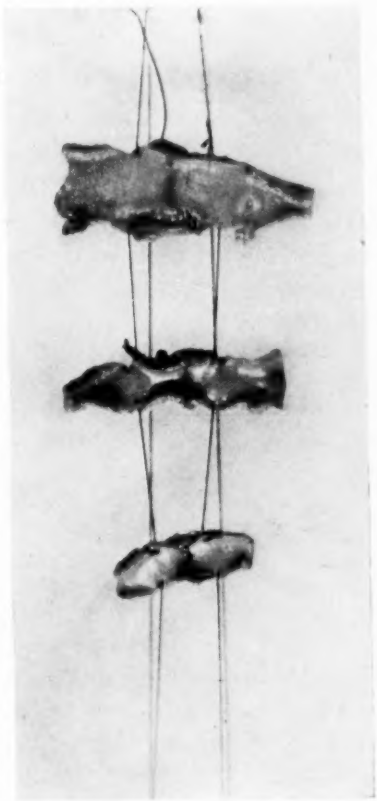
The handle of the instrument has been brought to its original position and the suturing has been completed. The instrument is grasped between the thumb and fingers and compressed to relax tension of the guy sutures and demonstrate whether there is a spurting point along the suture line.

FIG. 7.



Specimen from transfusion of blood. To the right is the vein, to the left the artery. Note the small amount of thread exposed to the lumen.

FIG. 8.



Three specimens of arterial suture from dogs. The upper specimen was removed a few minutes after operation, the middle specimen two days after operation, the lowest one 33 days after operation. The two upper specimens are carotid arteries, the lowest one is a femoral artery. For further description see text.

further increases the eversion of the margins of the vessel and renders it possible to place the sutures more accurately. The suturing is done toward the operator, and constant tension is kept on the suture by holding the thread in the left hand and so bringing the thread down snugly after each suture is placed with the right hand. The sutures are close together. In the carotid of a medium sized dog, there should be about five or six sutures between each guy suture.

When the second guy suture is reached, the handle of the instrument is depressed away from the operator till it lies horizontal (Fig. 4) instead of vertical. The whole instrument should then be slightly shoved toward the operator, so as to increase the eversion of the intima in the third that is being sutured. The suture is continued along the second third of the vessel's circumference in the same manner as in the first, only care must be taken to place the suture at the angle well inside of the guy suture, as the latter may cut the vessel somewhat and so cause leakage, and also because the vessel wall is pulled out more markedly at this point, which makes it necessary to take a deeper bite here in order to secure uniformity in the line of sutures.

When the third guy suture is reached the position of the instrument is again changed, the handle or main shaft being depressed toward the operator (Fig. 5). The position of the instrument now is such that the handle points to the operator while suturing the last third of the artery, which is exactly the opposite direction to its position while suturing the second third. The whole instrument is gently elevated to increase the eversion of the margins of the artery. The suture is continued along the last third of the artery, and when the starting point is reached the instrument is brought to its original vertical position.

The suture is carried about two stitches beyond the starting point, and is there finished by whipping it over twice after the manner of an over-hand suture, and running the thread under the loop before the loop is drawn tight. This holds the thread securely. The Crile clamps are then loosened gradually, the distal one first. The shafts of the instrument are grasped between the thumb and fingers and pressed toward each other so as to relax the tension on the guy sutures (Fig. 6). If any

spurting point occurs the clamps are reapplied, the pressure on the shafts is relaxed, and an extra suture is placed at the spurting point. This is rarely necessary in suturing arteries, though, where a segment of vein is grafted on an artery, a spurting point often occurs. If no point spurts, the guy sutures are cut close to the artery and the instrument is removed. The small amount of oozing immediately after the suturing is completed usually checks spontaneously, or at least after gentle pressure with dry gauze. If after slight pressure with dry gauze for a minute there is still any leakage of blood, a suture should be placed at the point of leakage. If too much pressure is made with gauze a clot may form. When the wound is closed the arterial suturing should be perfectly dry and free from any oozing of blood.

In discussing the advantages of this new method, let us first consider the merits of a continuous mattress suture in blood-vessel surgery. It is well known that in intestinal surgery the continuous mattress suture makes exceedingly smooth approximation on the peritoneal surface, and a minimum amount of thread is left exposed. In the case of a blood-vessel, the endothelial layer is on the inside of the vessel instead of on the outside, as in the intestine. The object in each instance is to approximate the endothelial surface, and by applying the continuous mattress suture, as recommended in the above technic, we obtain the same approximation and minimum exposure of the thread within the vessel as is seen on the serous surface of the bowel after the application of a continuous mattress or right angle suture. In blood-vessel suturing it is most desirable to have as little of the thread exposed to the current as possible, and this suture is more capable of fulfilling this requirement than any other continuous suture. In addition to this advantage, there is less likelihood of the vessel being cut with mattress stitches than with other forms of suture. This property of the mattress suture is recognized in general surgery and is utilized in sewing such tissue as muscles when cut transversely; where a single straight suture will cut out, the mattress suture, which grasps a loop of tissue at a right angle to the line of traction, will hold.

The advantages of the instrument have already been alluded to. Of course, to obtain satisfactory results it must be properly used. The guy sutures should be of about equal length from the buttons to the artery, so that no undue traction is made on any one suture. If the guy sutures are of equal length, the tension of all of them can be increased or diminished by regulating the suture that runs to the end of the short shaft. If the short shaft is pressed upon too forcibly when the last guy suture is applied, so much tension will be made that the guy sutures may cut the vessel wall unduly. This is very easily regulated, and when once the guy sutures are properly placed the tension all along the arterial wound remains exactly the same from the beginning to the end of the suturing. This insures uniformity of the sutures, and prevents the alternate stretching and relaxation that must occur every time the guy sutures are changed when they are held by hand. No skilled assistant is required, and in fact a blood-vessel can be sutured by the operator without any assistance at all, as he can hold this instrument in part of the left hand, while the thumb and index-finger of the same hand follow the thread as the sutures are placed. If a leak occurs it is easily demonstrated by loosening the clamps and relaxing the guy sutures by compressing the shafts of the instrument as described above (Fig. 6). The clamps are then reapplied and the leak accurately sutured with the vessel still held in the instrument. In this manner, any competent surgeon with some experience in experimental work on the arteries can confidently suture large vessels or perform transfusion of blood with a needle and thread. In both instances the same technic is used.

In transfusion of blood, where the artery of the donor is united to the vein of the patient, this method of suturing is particularly desirable. As pointed out elsewhere,[4] it is best to select a vein where a branch is given off. This branch is clamped with a mosquito forceps and will serve as a gauge to show the rate of flow. In my own experience, the flow in

[4] Journal A. M. A., Aug. 20, 1910.

transfusion is more likely to be unsatisfactory because of contraction of the exposed radial artery than on account of blockage at the site of anastomosis. Of course, this can be largely avoided by keeping the vessel covered with gauze saturated with warm salt solution. But it is necessary occasionally to inspect the vessels and, as a rule, the vessels are inspected oftener than is necessary and each exposure tends to increase the contraction. As the radial artery firmly contracts, it will almost shut off the flow of blood entirely. If this occurs when sutures are used for transfusion, a small probe can be passed through the venous branch, through the site of anastomosis, and up into the radial artery, thoroughly dilating it. The probe must be perfectly smooth, and should be anointed with vaseline before it is introduced; it must be withdrawn quickly, when it will be followed by a spurt of blood. The venous branch is then clamped as before, and the vessels surrounded with warm moist gauze. Such a procedure is impossible when a fixed cannula is used without the risk of seriously injuring the intima where the metal probe passes through the cannula. Suturing an artery or transfusion of blood can easily be done with this technic in ten to fifteen minutes after the vessels are exposed if the operator has had some experimental experience.

Suturing blood-vessels seems to be going through the same stage as intestinal suturing underwent fifteen years ago. At that time there were hosts of appliances of all shapes and descriptions for uniting severed intestines, but it was found that with a little practice, a needle and thread was superior to complicated buttons and bobbins, and these appliances have been generally abandoned. It is not improbable that history will repeat itself in the case of arterial suturing.

A NOTE ON THE DIVISION AND CIRCULAR SUTURE OF THE AORTA IN PREGNANT CATS.

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AND

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IN a recent article [1] we described in detail our adaptation of the Carrel method of end-to-end anastomosis of blood-vessels, using the abdominal aorta of the cat. During our experimentation we have encountered three cats which were pregnant; as this is a complication hitherto unmentioned in blood-vessel surgery, we think these three protocols worthy of a separate record.

(1) March 17, 1910: Female cat etherized; cœliotomy revealed a uterus containing five fetuses; hysterectomy, excision of one-half inch of the abdominal aorta, reimplantation of the segment by circular suture. After re-establishing the circulation there was no pulsation of the artery distal to the segment; gentle stripping of the implanted artery caused obstruction to disappear and pulsation became visible and palpable.

March 22: Cat alive, but walking unsteadily, eating fairly well.

March 24: Apparently in excellent condition.

March 26: Ninth day; cat found dead; autopsy revealed a small amount of pus in abdominal wound but no peritonitis; aorta found patent, no thrombosis. Lungs showed an extensive bronchopneumonia.

(2) May 24, 1910: Female cat etherized; cœliotomy revealed a uterus containing five fetuses; uterus and intestines retracted under hot towels, aorta clamped, divided, and united with circular suture; uterus and intestines replaced, abdominal wound closed. (Circulation interrupted for fifteen minutes; entire operation occupied thirty-five minutes.)

June 1: Cat is making uneventful recovery from operation, and pregnancy is apparently progressing normally.

We are indebted to Prof. W. T. Porter for the use of the Laboratory of Comparative Physiology in the Harvard Medical School for our experimental work.

[1] Ehrenfried and Boothby: The Technic of Arterial Anastomosis, ANNALS OF SURGERY, 1911, liv, 485.

July 1: Cat is in best of health, active and strong, and is evidently approaching full term.

July 10: During the night the cat delivered herself; one perfectly formed and healthy kitten found with its mother but no trace of the other four fetuses or of after-birth (there were many cats in the same cage, and they were probably eaten).

(3) July 14, 1910: Female cat etherized; cœliotomy revealed a uterus containing five large fetuses; uterus and intestines retracted under hot towels, aorta clamped, divided, and united with circular suture; uterus and intestines replaced, abdominal wound closed.

July 28: Cat has made uneventful recovery from the operation, is perfectly healthy, and is evidently approaching full term.

August 4: Cat to-day observed to have delivered herself during the night, but no trace of fetuses or after-birth found. We presume they were eaten.

CONCLUSION.—It is possible to completely interrupt the circulation of the abdominal aorta in a pregnant cat for fifteen minutes, divide the aorta, perform a circular suture thereof, and re-establish the circulation without interfering with the course of the pregnancy.

OBSERVATIONS UPON A SERIES OF FORTY-THREE LAMINECTOMIES.

BY CHARLES A. ELSBERG, M.D.,
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FIRST PAPER.

AMONG 43 consecutive operations upon the spine[1] during the past two years, laminectomy for tumor was performed in 13 patients. Of the 13 cases, 9 were extramedullary and 4 were intramedullary growths. Of the extramedullary, the bone and muscles were involved in addition to the meninges in 2 patients, while in 7 the tumor was entirely intradural. Of the latter, 2 were in the dorsal or lumbar cord, 5 involved the conus and the roots of the cauda equina.

There were in all 36 primary laminectomies and 7 secondary operations. In addition to the 13 patients with spinal tumor, there was one with a collection of fluid (arachnoid cyst ?). Posterior root section was done ten times; extirpation of diseased bone pressing on the cord twice; a peculiar disease of the posterior nerve-roots was encountered in one patient; two patients had an acute osteomyelitis of the vertebræ; one, a fracture dislocation; there were eight exploratory operations.

In the operative and post-operative treatment of the patients with spinal tumor, a number of observations were made which are recorded in what follows.

THE EXTRUSION OF INTRAMEDULLARY TUMORS OF THE CORD.

In all of the patients with intramedullary growths of the cord, the tumor was treated by the method of extrusion which has been recently described by myself and Dr. Beer.

[1] The greater number of these operations were performed by the writer at the New York Neurological Institute, a few were done at Mt. Sinai Hospital, New York. Six patients were operated upon by Dr. E. Beer (section of posterior roots, 4 cases; intramedullary tumor, 1 case; removal of cauda tumor, 1 case).

If, upon exposure of the cord, the growth was found to be an intramedullary one, a small incision was made in one posterior column over the tumor a few millimetres from the median line. The operation was then concluded for the time being, and the muscles, fascia, and skin sutured in the usual manner. About one week later, the wound was reopened and the tumor was found more or less completely extruded from the cord substance, so that it could be removed with little injury to the cord tissue. The tumor usually appears much larger after its extrusion, because of the œdema of the extruded mass.

We have thus far, in the Neurological Institute, treated four cases of intramedullary tumor by the extrusion method, Three of the four cases have already been reported;[2] a synopsis of the history of the fourth patient follows:

Intramedullary glioma of the cord (first, second, third, fourth cervical, and medulla); laminectomy and incision of cord; death from respiratory paralysis two days after operation.

D. C., laborer, thirty-seven years old, admitted to the Neurological Institute on the service of Dr. Fraenkel, on November 27, 1910. The patient gave a thirteen months' history of numbness in the left side of the face, neck, and upper extremity. Soon after the numbness the patient began to have some pain in the back of the neck, and at the same time the left upper extremity became weak. For six months before admission, increasing difficulty in walking; for three weeks, weakness in the right upper extremity. During the first few days' stay in the hospital, it was noted that the patient's pulse was weak and irregular at times.

The patient is a large, well-nourished man; he holds his neck rigid on account of the pain in the back of the neck. His gait is markedly spastic. Over the left side of the face, sensations of touch, pain, and temperature are much diminished. The left cornea is markedly hypæsthetic. There is a marked atrophy

[2] Elsberg and Beer: Amer. Jour. of the Med. Sciences, November, 1911.

[3] Elsberg and Beer: loc. cit.

of the left trapezius, sternomastoid, serratus, deltoid, supraspinatus, and infraspinatus muscles. All of the reflexes on the left side of the body are exaggerated; ankle-clonus and Babinski on the left side. Wassermann and X-ray examinations negative. No relief of pain by immobilization of spine.

January 18: Laminectomy (Dr. Elsberg): Removal of spines and laminæ of second, third, fourth, fifth, and sixth cervical vertebræ. Cervical cord found much enlarged. At the level of the third cervical segment a small cystic looking mass in the left posterior column. Aspiration negative. Small incision in posterior column 1 cm. in length, over the most prominent part of swelling; suture of muscles and skin.

For two days after the operation the patient did very well. On the third day he had several attacks of difficulty in breathing. On the evening of that day he suddenly stopped breathing. In spite of artificial respiration and active stimulation, the heart action became gradually poorer, until it ceased altogether.

The post-mortem examination showed that there was an intramedullary tumor which extended from the third cervical segment up through the cord into the medulla, where it had grown through the posterior surface of the medulla into the posterior fossa. The growth was an infiltrating glioma which had been slightly extruded through the incision in the posterior column, made at the operation. The field of operation was in perfect condition.

REMARKS.—The tumor was of such a size and in such a location that it was remarkable that the patient did not suffer from more marked medullary symptoms before the operation; it is certain that, in a short space of time, he would have died a sudden medullary death if no operation had been performed. No doubt the removal of the spines and laminæ diminished the resistance or support below, and this, together with the gradual downward movement of the tumor in the process of extrusion through the incision in the posterior column of the cord, had caused a pressure upon the medulla in the foramen magnum and thus hastened the medullary death. Had I removed part of the margin of the foramen magnum at the operation (which could have been done with ease), the sud-

den death might have been delayed, and, if the condition had not been beyond surgical relief, perhaps prevented. The case, therefore, taught us a valuable lesson. In operations for spinal tumors which extend high up on the cervical cord, it is advisable to remove part of the margin of the foramen magnum so as to prevent undue pressure upon the medulla by the extruding tumor (if medullary) or through a secondary œdema of the parts after the operation.

The Value of Extrusion in the Removal of Tumors of the Cauda Equina.—In three of four cases of large tumors surrounding the roots of the cauda equina, I have treated the tumors by extrusion with satisfaction. The amount of injury done to the nerve-roots is much diminished by this method, as the histories of the following cases demonstrate. All of the patients were suffering from extensive endothelioma or endothelial sarcoma.[4]

CASE I.—*Metastatic Sarcoma Surrounding the Roots of the Cauda Equina; Laminectomy and Removal; Death after Two Months.* M. S., forty-two years old, was admitted to the service of Dr. Collins at the Neurological Institute. Two years' history of pain, beginning in the back of the right thigh and in the small of the back. Urinary incontinence and impotence for nine months, stiffness of both lower extremities; numbness and sensations of cold in both feet. Symptoms steadily progressive.

Abdominal reflexes normal, cremasterics cannot be obtained; both lower limbs spastic and ataxic; absent knee- and ankle-jerks. Sensory disturbances over the distribution of the second, third, fourth lumbar and first to fourth sacral roots. Tenderness on percussion over first and second lumbar spines.

January 27, 1910: Laminectomy (Dr. Elsberg) twelfth dorsal, first, second, and third lumbar. Incision of dura revealed large reddish-brown tumor surrounding the lower part of the conus and the roots of the cauda equina. After a prolonged and tedious dissection, during the course of which several nerve-roots had to be divided, the tumor was freed from the nerve-

[4] This is a class of cases which have not been adequately described. They present a very characteristic clinical picture. These cases will be described in detail in a paper by Dr. Collins and the writer.

roots and removed. It was only slightly adherent to the dura, but it closely enveloped the nerve-roots, so that each root had to be carefully dissected out from the tumor tissue. Bleeding was only slight and was easily controlled. Suture of dura, muscles, and skin.

For several days after the operation the lower limbs were paralyzed. Three weeks after the operation he was sitting up in bed, and moving his lower limbs freely. All spasticity had disappeared.

The laminectomy wound healed by primary union. He did not, however, gain in weight, but became more and more cachectic. Soon he began to run irregular fever and to lose weight rapidly. Physical examination failed to show that there was malignant disease in another part of the body. He died eight weeks after the operation. Permission for an autopsy could not be obtained.

CASE II.—*Sarcoma Surrounding the Roots of the Cauda Equina: Laminectomy; Extrusion; Removal; Recovery.* Mrs. P., twenty-five years of age, service of Dr. Collins at the Neurological Institute. Pain in back, radiating down legs for two years, increasing loss of power in lower extremities with drop-foot; increasing difficulty in urination. Complete palsy of tibialis anticus group and of peronei on both sides; knee-jerks and ankle-jerks not to be obtained. Sensory disturbances in lower lumbar and sacral nerve-roots.

December 3, 1910: Laminectomy. Removal of spines and laminæ of eleventh and twelfth dorsal, first, second, third, fourth, fifth lumbar vertebræ and incision of dura, exposing very large tumor surrounding the roots of the cauda equina and extending upward around the conus. Tumor of soft consistency, of reddish-brown color, and not closely adherent to dura. Growth filled the spinal canal surrounding the nerve-roots of the cauda equina. As the tumor gradually bulged out of the canal it was determined to delay the removal. Suture of muscles and skin. Dry dressing.

December 10: Wound reopened. Tumor had been extruded to a great extent, and a great part of it lay outside of the spinal canal. A number of the nerves of the cauda were free of tumor. With little difficulty the greater part of the tumor was peeled

off from the roots of the cauda; some small pieces of tumor tissue had to be removed separately from between the roots. The tumor was easily freed from the conus and cord, leaving these structures covered by a thickened, very vascular pia mater. The inner surface of the dura was everywhere smooth and glistening. The tumor extended from the level of the eleventh dorsal vertebræ above to the end of the sacral canal below, it was fairly firm, and not very vascular. Pathological report: sarcoma.

After-course.—The wound healed by primary union. Gradual improvement in all symptoms. Return of full control of bladder. Steady improvement in power in lower extremities. Knee-jerks and ankle-jerks still absent. September 6, walking around with assistance; can sit and stand alone; knee-jerks and ankle-jerks still absent.

CASE III.—*Very Large Tumor Surrounding the Lower Part of the Cord and Cauda Equina; Laminectomy; Extrusion; Removal.* R. E., forty-one years old, service of Dr. Bailey at the Neurological Institute. One year history of pain in back and lower extremities, increasing loss of power in lower extremities; incontinence; impotence; sensory disturbances in legs. Steadily progressive symptoms. Lower limbs markedly paretic, especially the right; double drop-foot; no knee- or ankle-jerks; wasting of muscles in tibialis anticus and peroneal groups. Sensory disturbances over distribution of third and fourth lumbar and all of the sacral posterior nerve-roots.

June 14, 1911: Laminectomy (Dr. Elsberg), removal of spines and laminæ of twelfth dorsal, first, second, third, and fourth lumbar vertebræ, incision of dura. Enormous reddish-brown tumor filling up the spinal canal. Marked extrusion of tumor after incision of dura. Suture of muscles and skin, dry dressing.

July 22: Wound healed by primary union. Delay in operation due to weak condition of patient. Removal of large amount of tumor masses (Dr. Beer) after reopening wound. Most of growth removed in pieces with sharp spoon. Capsule excised as completely as possible.

After-course.—Wound healed by primary union. General condition improved. Slight improvement of sensory disturbances. No improvement in incontinence. Knee-jerks and ankle-jerks still absent. Pathological report of tumor: endothelioma.

CASE IV.—*Endothelial Sarcoma of Cauda Equina; Laminectomy (Eleventh and Twelfth Dorsal, First, Second, Third, and Fourth Lumbar); Extrusion; Removal; Recovery.* George S., thirty years of age, admitted October 1, 1911, service of Dr. Collins at the Neurological Institute. Two years' history of pain in small of back and lower extremities, sensory disturbances in lower limbs, increasing weakness. Weakness in lower limbs, absence of knee- and ankle-jerks; sensory disturbances over lower lumbar and sacral areas; tenderness over lumbar spine; rigidity of lumbar spine.

October 4: Laminectomy (Dr. Elsberg). Removal of spines and laminæ of first, second, third, and fourth lumbar vertebræ in usual manner. Dura very thin and bulged out by large, reddish-brown tumor. Removal of spines and laminæ of eleventh and twelfth dorsal vertebræ to reach upper end of growth. Tumor evidently growing between the roots of the cauda equina, pushing some of the roots backward but most of them forward. Tumor slightly freed from surrounding adhesion. Toilette of wound. Sutures of muscles, fascia, and skin.

October 10: Wound reopened. Tumor 10 cm. long found partly extruded from its bed in the spinal canal. A large number of nerve-roots now lying on the left side of the tumor. Larger part of growth removed in one piece. Numerous small fragments removed from between nerve-roots with sharp spoon. Bleeding moderate. Fragments of tumor tissue left behind without doubt. Toilette of wound; sutures of muscles and skin. Dry dressing.

October 21: Wound healed by primary union. Power in lower extremities improved. Some improvement in sensory disturbances. Unable to empty bladder so that catheterization is necessary. Knee-jerks and ankle-jerks still absent. General condition improved. To receive injections of Coley's fluid.

REMARKS.—The last three cases demonstrated the value of the extrusion method and the two-stage operation in these large tumors which surround the roots of the cauda equina. The difficulties met with in the removal of the tumor in Case I were very great, and by the necessary manipulations, much injury must have been done to the nerve-roots. In the other

three patients, the partial extrusion of the large tumors from the spinal canal made their connection with the nerve-roots much less intimate, hence their removal could be accomplished with less injury to the nerve-roots.

THE IMPROVEMENT IN SENSORY AND MOTOR DISTURBANCES AFTER THE RELIEF OF PRESSURE UPON THE SPINAL CORD BY THE REMOVAL OF SPINAL TUMORS, BONE DISEASE, ETC. THE DECOMPRESSIVE EFFECTS OF LAMINECTOMY.

In the eight cases above referred to and in a number of other cases,[5] I have made observations upon the disappearance of paralysis and of sensory disturbances, and the return of reflexes. It is obvious that the return of functions will vary with the variety and size of the tumor, the duration of the disease, the general condition of the patient, etc. Root pains usually disappear very rapidly, the most severe may disappear at once after the operation. After the removal of a tumor lying on the twelfth dorsal segment from a woman who had most violent pain referred to the right twelfth dorsal nerve-root for two years, the pain disappeared at once after the operation. In general, the sensory symptoms are the first to improve and the last to be entirely well; a disturbance of the deep muscle sense may persist for years after the operation.

In many cases, the improvement begins only after a number of days or weeks. In spite of the most delicate operative manipulations, all of the symptoms may at first become aggravated. In several patients in whom a laminectomy was performed in the upper dorsal region, the interesting observation was made, that all reflexes in the lower extremities could not be elicited for twelve to forty-eight hours after the operations. Similar observations have been reported by Bruns, Oppenheim, Flatau, and others.

In patients with advanced spinal symptoms of long dura-

[5] Extramedullary tumor of cord, 2 cases; osteo-arthritis of spine, 2 cases; arachnoid cyst, 1 case, etc.

tion, however, and especially in those with marked cauda equina symptoms, the beginning of the improvement may be delayed for many weeks or even for months. Absence of knee-jerks and ankle-jerks may persist for years after most of the other sensory and motor symptoms have disappeared. It is obvious that where actual destruction of pyramidal fibres has taken place, exaggeration of knee-jerks, ankle-clonus, etc., may persist for many years or be permanent. After an operation for spinal tumor in which there has been no injury to the cord or nerve-roots, the improvement will occur in the following order: sensory (temperature, pain), then motor, finally sensory (touch), last of all deep muscle sense and sense of position.

THE DECOMPRESSIVE ASPECTS OF THE OPERATION OF LAMINECTOMY.

In a number of exploratory operations for spinal disease in which no gross lesion could be discovered, I have observed for days or weeks after the operation, a marked improvement in the sensory and motor symptoms. These have consisted of diminution in exaggerated tendon reflexes, such as exaggerated knee-jerks, ankle-clonus and Babinski, and decided improvement in sensory disturbances. These have been so marked in some of our patients, that it was impossible to explain them as a psychic effect of the operation. There must be some other factor involved, such as circulatory changes or the effect of the spinal decompression by the free removal of a number of spines and laminæ.

THE IMPORTANCE OF CAREFUL HÆMOSTASIS IN SPINAL OPERATIONS.

The amount of discomfort suffered by the patient upon whom a laminectomy with opening of the dura has been done is, in many instances, in direct proportion to the amount of bleeding that has occurred within the spinal meninges. It is of great importance, therefore, to control even the slightest

oozing of blood within the dura, and to make every effort to prevent blood from the outside entering the spinal canal. It is often possible to leave the pia-arachnoid intact, so that the fluid under the pia remains clear. In the removal of a spinal tumor, the small vessels should be carefully caught with fine mosquito forceps and ligated with the finest of silk. The posterior spinal artery has many anastomoses, and a ligature can be applied to it in any part of its course, with impunity. Great care in preventing bleeding within the dura may prevent the paræsthesias and root pains which are occasionally observed after these intradural operations. Delicacy of manipulation is, of course, all-important, both to prevent bleeding and injury of the delicate spinal structure. Spinal nerve-roots should never be handled with forceps; if necessary, they should be lifted up with small strabismus hooks.

THE IMPORTANCE OF CAREFUL SUTURE OF THE DURA, MUSCLES, AND SKIN.

Careful closure of the dura by a continuous suture of fine silk will be the surest preventive of cerebrospinal fluid leakage after a spinal operation, and the greatest safeguard against meningeal infection therefrom. The careful suture of the muscles and fascia will also contribute to this end. Good union of the muscles in their proper relations is important for the complete restitution of the functions of the vertebral column. It is well known that the main support of the vertebral column depends upon the intact condition of the bodies of the vertebræ, but the post-operative mobility of the spine will be much better if the muscles and fascia have been well approximated. I have not infrequently had to remove as many as six or seven spines and laminæ, and have seen the patients with functionally perfect spinal columns after their recovery.

PROPHYLAXIS AND TREATMENT OF EPITHELIOMA OF THE LOWER LIP.

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AND

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THE extirpation of the neoplasm is, of course, the main point in the treatment of cancer, but this is not the question considered in this paper. This discourse treats of the origin and the recurrence of cancer of the mucous surface of the lower lip.

Almost all epitheliomas of the red of the lip begin on the surface and erode downward, and almost all if not all of these that so begin superficially are end results of seborrhœa.

This seborrhœa is connected with a line of sebaceous glands that anoint the exposed mucous surface. The line of these glands is often visible in lips that appear to be normal, as a slightly shaded or as a glittering band that stretches like a bow across the front of the lip between one corner of the mouth and the other, and in the median lines about half a centimetre above the cutaneous border. If the lip is seborrhœic, this line may be dry, brown, and facetted, it may be scurffy, it may be crusted, it may be keratotic and run along the apex of the lip as a white rough crest, or it may be heaped up in horny, tightly adherent masses. Although the seborrhœa tends to limit itself to this line, yet it may be much broader and interest the whole of the exposed mucous membrane. As in all these degenerative tendencies, the different symptoms show different degrees in different individuals. A patient may have marked seborrhœa oleosa of the face, with little tendency to form crusted localized patches and epithelioma. The lip on another may be markedly seborrhœic, while the skin is only slightly affected. A patient may have decided crusting of the

lip with no epithelioma, while, on the contrary, he may have an epithelioma with a seborrhœa that is only well seen on examination with a lens.

As regards the development of cancer, seborrhœa acts on the lip as it does on the cutaneous surface. The seborrhœa, at some point, becomes more decidedly crusted, and if this crust is scraped off, the tissue beneath will be found eroded. If this eroded portion is examined microscopically, it will be found cancerous.

Although the patient, whose history is about to be given, had epithelioma of the lip and coincident cutaneous cancer, and although we believe that the cancers developed in both situations because of the patient's seborrhœa, we do not maintain for a moment that the two kinds of cancer, that of the lip and that of the skin, are identical. The decidedly greater malignancy, the more rapid growth, the liability to form metastases, and the different histological structure put cancers of the lip in a different category from those of the skin. But all these differences are connected with differences in the nature of the infiltrating epithelial cells, and have nothing to do with the causes inciting these cells to pathologic activity. The same whip may incite both a race horse and an ox to unusual activity, but the animals themselves and the speed elicited are very different.

In reading the above, one might suppose that no attention is to be paid to irritation as a cause of epithelioma, which would be contrary to all clinical experience. In smoking, the irritation of the pipe, the drying effect, and the irritation of the smoke, of the nicotine, and of the products of combustion, all fret the sensitive lip of those having seborrhœa. The patient, the subject of the present paper, had been a heavy smoker, but it was noteworthy that his greatest and earliest cancerous degeneration took place, not on the lip, but on the skin of the face, and not until very recently had anything like cancer appeared on the lip. In regard to the irritations, it is also well known that atmospheric influences, such as heat, cold, strong sunlight, and rude weather act particularly

harshly on the skin of those having seborrhœa, and aid in the development of epithelioma of the face and hands. The well-known "sailor skin" of the fisherfolk of the North Sea and German Ocean is an example of this. In the same way we have seen seborrhœic crusts and a consequent epithelioma of the exposed mucous membrane of the lower lip correctly referred to exposure in driving an automobile across the hot sandy valleys of California. But in all probability the influence of these external agents has frequently been exaggerated. Pusey, for instance, in regard to smoking, remarks that he had run across proportionately as many cancers of the lip in non-smokers as in smokers, and this agrees with our experience.[1]

The condition of a seborrhœic lip is best explained by referring to the accompanying photograph (Fig. 1). The black irregular patches on the lip were not really black, but were red crusts of dried blood. In the middle line and to the patient's right these scabs were irregularly scattered over the exposed mucous membrane. To the left of the median line is found a characteristic row of small black dots just above and parallel to the cutaneous margin along the sensitive seborrhœic line above mentioned. This crusting, which is best seen by examining the photograph with a low power lens, ran to the left corner of the mouth. Although the linear arrangement of the disease was not so marked to the right of the median line, yet the roughness and desquamation could be seen to also run out to the right corner of the mouth, so that the whole exposed red surface of the lower lip was diseased from corner to corner. When the crusts were scraped off two shallow erosions were exposed, both of them under the heaviest crusting to the right of the median line. On applying trichloracetic acid to these erosions, the posterior wall of one of them showed a fairly deep, easily bleeding crack, indicating that at this point epitheliomatous infiltration had extended well down into the subjacent connective tissue.

This condition of the lip was only part of a general seborrhœic process affecting the exposed surfaces of the face, neck,

[1] The Principles and Practice of Dermatology, Wm. Allen Pusey, Second Edition, p. 907.

ears, and back of the hands. The patient was a miner, forty-seven years of age, whose habits were good with the exception of being a heavy smoker and a hearty cream and butter eater. We mention this because we have reason to suppose that the ingestion of a large quantity of milk fat inclines toward seborrhœa, and smoking is, of course, understood to be definitely related with cancer of the lip. The patient first came to us Sept. 17, 1909, with seborrhœic crusted patches scattered over his face, and a superficial ulceration near the inner corner of the right eye on the side of the nose. There was a large, prominent, heavily crusted, granulating mass on the left cheek, and there were many scars on the face where former lesions had been.

Because of the exuberant granulations of the lesions of the left side of the face, and the scarrings, which we afterward ascertained were the result of former operations, a Wassermann test was made, resulting negatively. He was, however, given iodide of potash and injections of salicylate of mercury, but these had no effect on the condition.

The lesions near the left corner of the eye were curetted and cauterized with a Paquelin cautery, and those of the left cheek and left side of the neck were curetted and cauterized with pure chromic acid crystals, after which the resulting crusts were removed, and the raw surfaces were exposed to X-rays.

Histologically all these lesions were found to be typical epitheliomata.

On examining the skin of the face, aside from the crusting and the ulceration, it could be seen to be profoundly seborrhœic. The mouths of the sebaceous glands were patulous, the skin was greasy in some places and red and desquamative in others, and the complexion, where it was not reddened by inflammation, was a straw yellow. This yellow color in many places shone through the skin as small granules, and was evidently due to diseased sebaceous glands. Some of the surface was covered by greasy crusts, and in the photograph (Fig. 2), these can be seen as black spots, representing, in some instances, where the process has gone on to epitheliomatous erosion. In fine the skin of this man's face showed an inveterate tendency to malignant epithelial degeneration, and was an excellent example of epitheliomatosis. The exposed mucous membrane of the lower lip participated in this same tendency.

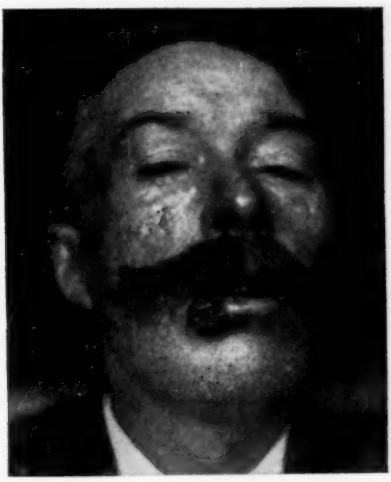
FIG. 1.

Seborrhœic crusting of the lower lip undergoing cancerous degeneration.

FIG. 2.

Large scar of the left cheek resulting from curetting and cauterization with chromic acid. The scar is smooth and free of seborrhœa. Anterior to the main scar there is an irregularly scarred surface where some of the sebaceous glands were not destroyed. On these intact patches of skin seborrhœa has developed and consequent small epitheliomata, shown in the photograph as black dots.

FIG. 3.



Photograph loaned by Dr. Wm. Pusey, showing an epithelioma together with dark patches on the mucous surface of the lower lip, that are probably seborrhœic. Scars and seborrhœic patches are seen on the face, and what is probably an epithelioma on the right cheek.

It is surprising that a condition having such grave consequences should receive so little attention from dermatologists. The reason it is slighted by surgeons is more evident, as their training is not such as to lead them to pay much attention to a scurffiness of the lower lip. They meet with graver situations that demand instant action, and this action being taken, their work is done. They daily "walk between the living and the dead," and a homily to a patient in peril of his life, laying out to him, in long-winded phrases, how he came to fall into trouble, would be highly inappropriate. When they are consulted, the symptoms of the cancer are so prominent and so grave as to hide or to overtop all others, and any other symptoms on the lips are looked upon as trifling secondary appearances. Furthermore, for some time after the operation is over and the wound is healed, the seborrhœic symptoms of the adjacent mucous membranes are much diminished, on the well-known principle that in the presence of an inflammation of great intensity an inflammation of lesser intensity vanishes. Psoriasis is a striking example of this principle, where the eruption will disappear entirely on the patient's getting pneumonia, to reappear shortly after recovery from the pneumonia. If a man wishes to get an idea of what an advanced stage a frankly ulcerating epithelioma represents, let him have some experience in curetting keratotic seborrhœic patches from the skin, such as those seen in the case above reported, and he will be surprised at the depth of the rotten erosions under some apparently superficial crusts. As above mentioned, there were two well-marked erosions hidden under the crusts of this man's lower lip. When a patient presents himself with a crusted lower lip, it should be carefully examined, not alone with the naked eye, but also with a low power lens. Every man should carry such a lens, and as Grindon says, his affection for such an instrument should not be Platonic, he should use it.

There are several reasons why dermatologists do not mention this condition. In the first place, because of the red color of the mucous membranes, inflammations are not as readily

recognizable on them as on the skin. Then again desquamation, that plays such a rôle in the symptomatology of the skin, has to be very severe before it becomes evident on the moist mucous membranes. Furthermore, many dermatologists feel that they are not interested in the lips any more than in the tongue, and they are especially not interested in cancer of the lips as being so evidently the surgeon's work. Therefore, as the condition is on the border both as regards treatment and situation, between two stools the patient falls to the ground.

The condition, however, has not escaped Fordyce, who for so long has been interested in the pathology of the lips. He significantly remarks, in speaking of labial epithelioma, "a number of primary changes in the surface epithelium may precede ulceration or tumor formation. Hyperkeratosis over a limited area, followed by fissure and later by ulceration, is often observed."[2] We can subscribe to all this except the assumption that only a limited area is affected. If these hyperkeratotic lower lips are examined with a low power lens, we are sure most of them will be found diseased from one corner of the mouth to the other. Fordyce, moreover, does not, in this article, connect up the epithelioma of the lip with seborrhœa, which to our mind is the chief point of interest. And we ourselves have been among those who have long ignored this condition of the lip and its relationship with seborrhœa of the skin, and now that our attention is drawn to it, are surprised at its frequency.

The matter of treatment is of the first importance. In the man, the subject of the photographs, whose history is given in the present paper, the seborrhœa was in an advanced state as indicated by the bloody crusting, and the whole lip was curetted and burnt with trichloracetic acid. Trichloracetic acid is an exceedingly powerful keratolytic, possibly the most powerful one we possess, but it must be handled with care. Immediately after applying it, its action should be controlled by the application of wet pledgets of cotton. After the crusts

[2] Handbook of the Med. Sciences, vol. xi, p. 683, by John A. Fordyce.

caused by the caustic are cast off, the lip should be treated with X-rays. Care in watching the effect of this remedial agent is also necessary, as a burn of the mucous membrane may be a serious matter. The use of the X-rays, so efficacious in the seborrhœids generally, is here at its best, and is by far the best agent we possess. The ray's action is not deep, however, and this accounts for its bad reputation in epithelioma of this region where cancer is so apt to strike in deeply and quickly. For the seborrhœic eczema itself, however, and for the shallow erosions, there is nothing better. This accounts for the occasional wonderful effect in cancer in such cases as mentioned by Hartzell at the last meeting of the American Dermatological Association. In all probability the infiltration in such instances is far more superficial than clinically it appears to be. We have before called attention to the deceptiveness of the depth of the infiltration of cancer in this region. When it appears to be shallow it is often deep, and when it appears to be deep, its apparent depth is often caused by a coincident inflammation. In this matter there is no absolute trust to be put in anything short of curetting.

The statistics of reliable surgeons as regards recurrence in cancer are interesting. Serafini, in reporting results in 100 cases, says that recurrence took place in the lip in 24, and in the submaxillary region in 17.[3] J. Clark Stewart says that after the radical operation, although he cannot give exact statistics, he believes that the recurrences will be less than 10 per cent., and that most of these in reasonably early cases will be local.[4]

If we are correct in our view of the early pathology of many of the epitheliomas of the lip, local recurrence is a perfectly natural event, as in these cases the whole lip is affected with a disease that naturally eventuates in epithelioma. For those, therefore, who would rather remove a diseased member

[3] Considerazioni statistiche sull'epitelioma del labbro, by G. Serafini, Gazetta degli Ospedali, p. 644, Abst. in Jour. A. M. A., Sept. 8, 1906.

[4] The Radical Treatment of Epithelioma of the Lip, Jour. A. M. A., Jan. 15, 1910.

than patch it, the radical removal of the entire mucous membrane of the lip, when seborrhœa of the lip exists, would be the only logical course. But as seborrhœa of the lip is usually associated with advanced seborrhœa of the face, and any restitutory flaps got from the patient's own face would also be seborrhœic, then the academically logical procedure would be to flay the face. In the subject of the present paper it would be absolutely necessary to flay the whole face, as the man was affected with a form of seborrhœa showing a peculiar and inveterate tendency to epithelioma; the form that, as before mentioned, is known among dermatologists as epitheliomatosis.

Reference has been made to the amenability of seborrhœa of the lip to treatment. This statement must not be taken as meaning that either the constitutional or cutaneous seborrhœic condition can be cured. This can be no more cured than gout, but many of the seborrhœic manifestations may be controlled for a whole lifetime, and for this many patients are rightfully and devoutly thankful.

ACUTE, SPONTANEOUS PERFORATION OF THE BILIARY SYSTEM INTO THE FREE PERITONEAL CAVITY.*

A REPORT OF SIX CASES FROM THE PRESBYTERIAN HOSPITAL OF NEW YORK AND 108 CASES FROM THE LITERATURE.

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HAVING personally had two cases of perforation of the gall-bladder into the free peritoneal cavity, my attention was called to the subject and I have gone over all the histories of operations on the biliary system in the Presbyterian Hospital for the past fifteen years. There were 365 such operations, with six cases in which the bile had extravasated through a perforation in the biliary system into the more or less free peritoneal cavity. Such perforations are rare, and not many of these cases occur in the experience of any one man. One is, however, likely to meet with such a case at any time, and one should not be taken off one's guard when confronted with such a condition.

It has seemed to me that something might be learned from going over the recorded cases in the literature. I have been able to collect 108 cases of perforation into the free peritoneal cavity and a table of them appears at the end of this article. The six cases which occurred in the Presbyterian Hospital are as follows. But two of these six died.

CASE I.—Chinaman, thirty-eight years of age. History 13622, Sept. 25, 1911. Ambulance. History difficult to get and through an interpreter. Slight attack similar to present illness several years ago. Attacks of digestive disturbances. Onset sudden three days ago, with epigastric pain, nausea, and vomiting. Next day pain localized in right lower quadrant, radiating up

* Read before the New York Surgical Society, November 22, 1911.

and down. No vomiting since yesterday but pain is getting steadily worse. Bowels constipated for three days.

Examination.—Well nourished but prostrated. Leucocytes, 10,000; polymorphonuclears, 85 per cent.; pulse, 114; temperature, 101°. Abdomen full, distended generally though not extreme. Does not move with respiration in lower half and only slightly above. Whole abdomen feels resistant and walls are tense, preventing palpation freely. General muscular rigidity but most marked in right lower quadrant. General tenderness but acute only in right lower quadrant. A little above McBurney's point, where slight pressure causes pain, there is sense of a mass about the size of a large orange, exquisitely tender. Tympany everywhere except a little dulness in each flank.

Clinical Diagnosis.—High gangrenous appendicitis with spreading peritonitis.

Operation at once, Dr. McWilliams, at midnight, Sept. 25, 1911. Gas and ether. High McBurney incision made. On opening peritoneum turbid, greenish-yellow, somewhat purulent, odorless fluid escaped, being free in cavity. Appendix not located. Cæcum involved in mass of recent adhesions. On passing finger upward separated weak adhesion, following which there was a gush of great quantity of bile mixed with flocculi. Right rectus incision over gall-bladder emitting large amount of bile. Omentum adherent to liver. Separated. Great difficulty in finding gall-bladder. It was found deep in posteriorly, very small and contracted, with a perforation admitting tip of finger in cystic duct directly over a large curved calculus. Gall-bladder incised and stone removed. On account of patient's condition, nothing further done. Tube sewn into bladder and two tubes into Morrison's pouch. Closure about tubes.

Patient in poor shape after operation. Infusion 1200 c.c. salt solution with adrenalin 20 minims. Died next morning, eight hours after the operation. No autopsy.

Result of Cultures.—Smears, many pus-cells but no bacteria. Cultures. Predominating cocci in groups and a few gram negative bacilli.

We have in this case both the mechanical and infectious factors present. How much the infection had to do with the perforation it is difficult to say, but the stone had certainly

ulcerated the duct which was tightly drawn over the large stone. Had this man been operated upon on the first day of his illness, there might have been a chance for his life, but the form of infection, streptococci, is against any form of peritonitis recovering. It was also unfortunate that a diagnosis of appendicitis was made, for there was evidence of beginning adhesions about the cæcum, and had the gall-bladder been opened at the beginning the peritoneal cavity would not have been so soiled.

CASE II.—Man, aged sixty-seven years. Admitted August 20, 1911. Ambulance at 3 P.M. Operator Dr. McWilliams. Complaint, pains all over abdomen, mostly on right side. About two months ago patient had very severe attack of pain on right side just below ribs. Had to stop work for a week. Had constant attacks of nausea and vomiting. Appetite poor. Bowels constantly constipated. Pains gradually wore away. Well until yesterday when suddenly, while bending over a lathe, sudden abdominal pain, so severe that patient could not stand up and knees were drawn up while in bed. Pain was all over abdomen, but most of the tenderness below ribs and lower down on right side. Nausea was extreme and he vomited a great deal of greenish-brown fluid. Took cathartic and bowels moved well.

Examination.—Markedly prostrated, tongue heavily coated. Pulse 88, fair force, slightly irregular. Temperature 99.4°, leucocytes 24,000, polymorphonuclears 92 per cent. Abdomen held rigid, tympanitic over all, with partial obliteration of normal liver dulness. Entire right side of abdomen very rigid, boardlike as one finds in stomach perforation, extending to a less degree to left rectus. Excessive tenderness just above right internal ring. Left inguinal hernia, but easily reducible. Right external ring dilated but no impulse. No peristalsis could be heard over abdomen. Some tenderness on rectal examination.

Clinical Diagnosis.—Intestinal obstruction, origin unknown.

Operation at once. Kammerer incision over appendix. Bile poured out of wound in great amount. Removed by passing Blake's irrigating tube into pelvis. Vertical right upper rectus incision. Large amount of bile escaped with particles of fibrin mixed with it, and pus. Large perforation of fundus. No stones in bladder, but finger felt a large rough one impacted in cystic

duct. Extracted with Blake's gall-stone forceps. Common duct free, but foramen of Winslow obliterated. Rubber tube sewn into opening in gall-bladder, and the edges of the bladder inverted about the tube by two purse-string sutures of plain catgut. Two rubber tubes, one containing gauze strip, into Morrison's pouch. One tube in appendix wound. Both wounds closed about tubes.

Patient made an uninterrupted recovery. Discharged Sept. 22 to his own physician, with a granulating wound discharging a small quantity of bile. Patient seen, Dec. 1, 1911. Entirely healed and perfectly well. No gastric nor intestinal disturbances.

CASE III.—Man, twenty-six years of age. Admitted Jan. 20, 1907. Operator, Dr. McCosh. Private patient. Three years ago attack of jaundice, grew deeper for a few days, and one night attack of pain for an hour in right hypochondrium. Five months ago similar attack but much severer, lasting for five days and with deep jaundice. Four months ago another attack and also three weeks ago, which last attack has not as yet subsided. Skin jaundiced, stools clay-colored. Pain now severe in right hypochondrium.

Examination.—Prostrated, deeply jaundiced. Abdomen held rigid on entire right side, most markedly so in right upper quadrant. Tenderness over whole of right side of abdomen and dulness over gall-bladder region. Temperature 101°, pulse 104, leucocytes 11,660, polymorphonuclears 80 per cent.

Operation at once. Incision over gall-bladder, which was found gangrenous and perforated at fundus, and surrounded by large amount of bile and pus. No stones found anywhere nor in common duct. Cholecystectomy. Tube into stump of gall-bladder. Uninterrupted recovery.

CASE IV.—Male, forty-nine years old. On Medical Division for nine days. While there temperature 99.5° to 102.4°. Leucocytes on admission 36,000, on day of operation 40,000. When brought in gave a history that three weeks ago, severe frontal headaches and diarrhœa. Two weeks ago began to have pain in right upper quadrant. Next day went to bed with a temperature of 102°. Chill the day before admission. No vomiting, bowels loose. Two days before admission became acutely delirious and was then brought into the hospital.

Examination.—Large mass made out occupying right side of abdomen, tender, and muscular rigidity. Dulness over it, evidently an abscess.

Operation, Dr. Brown, Sept. 20, 1901. Incision through right upper rectus, giving exit to large amount of bile and pus with a stinking odor. Numerous adhesions. Gall-bladder perforated at fundus, and from it was removed a single, non-facetted stone, the size of a pigeon's egg. Tube drainage of bladder and a second tube into the space below the gall-bladder.

Uninterrupted recovery. Discharged Oct. 19, 1901, with a sinus still discharging pus.

CASE V.—Male, forty-nine years of age. Private patient of Dr. Blake. Three months ago vague shooting pains, worse when stomach was empty and relieved by food. No vomiting. Alkali treatment, and got well. Two days before admission, marked abdominal discomfort, vague in character, localized in right upper quadrant of abdomen and small of back. Sense of fatigue and constant desire for food. These symptoms continued until to-day, when he was seized with sharp pain localized in right upper quadrant.

Examination.—Acute tenderness in right side of abdomen, more so over gall-bladder, with great muscular rigidity. No mass could be made out.

Operation at once. Bile free in abdomen and a collection of it in right gutter. Gall-bladder gangrenous in spots and contracted. Interior full of small stones. Gall-bladder removed. General abdominal irrigation with Blake's irrigating tube. Tube into stump and two tubes in bed of gall-bladder.

Uninterrupted recovery. Smears and cultures taken at the time of the operation were sterile.

CASE VI.—Male, thirty-one years of age. Operator, Dr. Hawkes, March 17, 1906. An Italian. Heavy drinker up to three years ago. Never an attack similar to present one, which began four days before admission with sudden onset of pain under right lower ribs, with chill, fever, nausea, vomiting, prostration, and constipation. Pain did not radiate and was increased by movements in bed. Vomitus contained food remnants, no bile nor blood. Pain continuous ache, gnawing, not colicky, and none in shoulder. Did not notice that he was jaundiced until attention was called to it in hospital.

Examination.—Temperature 101°, pulse 120, leucocytes 15,000, polymorphonuclears 84 per cent. Exquisite tenderness and rigidity of right rectus, especially its upper part. Respiratory

movements much limited on right side. Somewhat distended. On account of rigidity and tenderness, no mass could be made out, but marked flatness below right costal arch. Deeply jaundiced.

Operation: Liver edge found adherent to transverse colon and to anterior abdominal wall by recent adhesions. Gall-bladder not made out. On breaking through adhesions toward duodenum, profuse discharge of thick, creamy, foul-smelling pus mixed with bile. Rubber drainage tube, surrounded by gauze.

After-course.—Jaundice never lessened. Profuse discharge of bile from wound. Had occasional chill and sweat. Lost ground gradually. Temperature remittent, as high as 103° some days. Leucocytes on April 3, 39,000, on the 5th, 62,300, with polymorphonuclears 91.5 per cent. Went into coma and died on the twenty-first day after operation. No autopsy.

Pathology.—The ordinary peritonitis arising from the gall-bladder is usually due to simple diffusion of infection through its walls to the peritoneum. It may result in a collection of pus of greater or less extent about the gall-bladder, but it is almost always well walled in by adhesions and represents a beautiful example of curable localized peritonitis. A very rare condition indeed is a generalized peritonitis due to lack of adhesions and without perforation. Korte has, however, reported three such cases. There are four cases recorded in the literature in which bile was found free in the peritoneal cavity, but in which there was no perforation of the biliary system. One is by Richardson, who says: "In one instance I found the right upper quadrant flooded with bile which had escaped from a gall-bladder that was apparently normal. Drainage was successful." Similar cases are recorded by Clairmont, Schievelbein, and Finsterer.

Much more serious, however, in its consequences and with a mortality rate not much under that of perforations of the alimentary tract must be ranked perforations of the biliary system into the free peritoneal cavity. Normal bile is sterile and is fairly well tolerated in large amounts and for a long time by the peritoneum, in which is set up a chronic irritation which results in the walling-in of the bile. This is well illus-

trated in traumatic rupture of the gall passages. Witness the interesting case of Garre, in which, two months after the injury, a large quantity of bile was evacuated and the patient was then cured by hepatocholangio-enterostomy; or the case of Hildebrandt, in which operation on the twenty-third day after the injury disclosed a tear in the hepatic duct, recovery following.

In rabbits Noetzel has demonstrated that after an aseptic laparotomy the gall-bladder can be incised and left to drain into the free abdomen, after which the abdominal wound is tightly closed. The animals regularly survived this procedure. In a second set of experiments, he demonstrated that, after opening the peritoneum, the animals recovered after infections were introduced into the cavity, of certain amounts of *Staphylococcus aureus,* in other animals of *Bacillus coli communis,* in others of *typhoid bacilli,* and in others of *streptococci.* He also demonstrated that if even smaller amounts of these organisms were injected into the abdomens of animals and, at the same time, their gall-bladders were incised and left open in the abdomens and the abdominal wounds were then closed, the animals regularly died of septic peritonitis. These experiments show the deleterious effect of bile in contact with peritoneum in exalting the virulence of the organisms. In addition bile diminishes phagocytosis, and by this double mechanism it decreases the means of natural defense of the peritoneum toward infection. Conradi has shown that bile for typhoid bacilli is a good culture medium. He has also shown that the addition of bile to a normal blood-serum promptly does away with the bactericidal properties of such serum, for, if we take 0.3 c.c. normal guinea-pig serum in a dilution of 1 to 80, we will find that this amount will kill 20,000 typhoid bacilli in two hours. If we now add 1.1 c.c. of bile to the same amount of normal guinea-pig serum, a bactericidal effect of the serum cannot be demonstrated, but on the contrary the added typhoid bacilli will grow without any hindrance.

Neufeld and Handel have shown through experiments

that this paralytic effect upon the bactericidal quality of the blood evidently rests upon the energetic binding of the complement with the salts of the bile. According to them, sodium taurocholate unites not only with the bactericidal complement, but also with the hæmolytic. These experiments explain why such a rapid destruction of the animals takes places when bile is mixed with weak infections in the abdomens of the animals. There results a great decrease in the bactericidal properties of the serum poured out into the abdomen in response to the irritation, and the animals die of sepsis, or rather of septic peritonitis.

Etiology of Perforation.—We may group these as follows:

1. Rupture from overstretching, with or without stones.

2. Perforation from pressure of a stone upon the wall, causing ulceration.

3. Perforation from gangrene, due to (*a*) thrombosis of vessels, with or without stones; (*b*) cutting off of circulation from pressure of a stone; (*c*) diphtheritic, ulcerative infection of wall, with or without stone.

It is not necessary to do more than state these facts, and discussion of them would be superfluous. The important point from a prognostic and therapeutical aspect of the subject is the amount and virulence of the infection present in the biliary system at the time of the perforation. We may group the cases then into two classes:

1. Those patients with latent stones in their biliary systems who have had no attacks of infection for some time. The contained bile is evidently not perfectly sterile, and if one were to take cultures from it, one would find numerous pathogenic bacteria, but they are actually well tolerated. Such a bladder may become distended, due to obstruction from impaction of a stone in the cystic duct or neck of the bladder, or, if no stones be present, from stricture of the duct with a coincident swelling of the mucous membrane, or from a kink in the cystic duct. Its walls may become paper-thin from overstretching, or very brittle from old chronic inflammation, or weakened from ulceration due to the pressure of a stone. In

such conditions it may be brought to sudden bursting by reason of the compression exercised upon it by the abdominal muscles in the act of coughing, or vomiting, or of bending over. There results a pouring out into the peritoneal cavity of a quantity of bile of a little septic character. It is mechanical in origin and infection plays a small part in the process. There is no great reaction of the peritoneum as a result of its contact with the bile, save in the formation of more or less abundant fibrinous adhesions. An intervention leads to a good prognosis, provided it be not too long delayed, for it prevents the development of secondary infectious complications which are likely to follow if one abandons the patient to his own means of defense; for as we have already seen, the previously existing latent infection may become exalted in its virulence, due to the bactericidal effect of the serum poured out into the peritoneum being diminished by reason of its mixture with bile, while at the same time there is no exit to the infectious fluid which itself is a good culture medium. In addition, one must not lose sight of the fact that infectious agents may emigrate directly from the intestinal canal into the peritoneal cavity through the perforation. Blake reports a case in which there was a primary abscess about the gall-bladder which later burst into the general peritoneal cavity with a fatal issue.

2. The second and grave type is that in which the perforation is directly due to infection and its results. There is present a more or less acute cholecystitis, with obstruction, and the gall-bladder may rupture from increasing tension or through a spot of gangrene of its wall, which may occur because of the cutting off of the circulation through thrombosis of its vessels or by reason of the pressure of a stone. Or an abscess situated in the wall may rupture, thus weakening the wall and leading to a perforation through distention. The process is much less mechanical than infectious, *i.e.*, the calculus plays a secondary rôle, and may be entirely absent. Obstruction may occur through the swelling of the mucous membrane dependent upon the intense inflammation of the

mucous membrane of the cystic or common duct. The perforation may be very sudden and acute, so that the peritoneal cavity is inundated by a very septic fluid with a resulting more or less general peritonitis. The prognosis in such a case may be very grave and may tax the surgeon's judgment to the utmost. A contracted gall-bladder will not contain very much fluid and, if, at the time of rupture, there be no relief in the obstruction, it will take several days for much bile to collect in the abdomen. If, on the other hand, the gall-bladder be thin-walled and much distended, the amount of fluid escaping through the perforation will be very large.

Between these two types there are all grades of commingling. In some cases there is difficulty in saying which element predominates, the mechanical or the infectious. It would seem in some patients with chronic empyema of the gall-bladder as though the calculus and the microbes mutually agree to end in perforation. In the vast majority of cases, perforation of the walls does not progress so rapidly as to take the peritoneum unawares, so that adhesions have time to form. In the rare case, however, with rapid perforation, no adhesions are present, and the rapidity and extent of the consequent peritonitis will depend on the amount of the extravasated bile or pus, and the virulence of its contained organisms. A pinhole perforation of a contracted bladder with a stone blocking the escape of bile will cause the development of a slow, more or less localized peritonitis, while a large sudden perforation in a much distended and infected bladder will cause an overwhelming general peritonitis similar to that which we find in perforation of the stomach or duodenum.

The gall-bladder mucosa presents numerous alveoli formed by fibromuscular bands. They are of various sizes and shapes, and in them we often find large or small calculi which are difficult to enucleate and are, as it were, let into the wall. The alveoli also contain septic fluid and are therefore an excellent culture medium for micro-organisms. The result is an ulcerative process which may lead to perforation and peritonitis. Dieulafoy says that the *Bacillus coli communis* seems to be an essential agent in the ulcerative process. Certain it is that

nothing can be elicited from the reported cases as to the bacteriology of these perforations, for in but very few cases have cultures been taken at the time of operation.

Of 90 cases in which the situation of the perforations is mentioned, 82 of them, or 91 per cent., occurred in the gall-bladder, 3, or 3.3 per cent., occurred in the cystic duct, 4, or 4.4 per cent., in the common duct, while but 1, or 1.1 per cent., occurred in the hepatic duct.

In 80 out of 108 cases, or 74 per cent., stones were found at the time of the operations for perforation. From this fact we may infer that calculi, single or multiple, are a great factor in causing perforation. In 14 cases, or 13 per cent., it was found that no stones were present after adequate search. In the 14 remaining cases, or 13 per cent., stones may or may not have been present, as no mention is made of them. Many of these cases were simply drained without search being made for stones.

In but 9 cases is it distinctly stated that gangrene was present. It usually was simply a small area of gangrene, and through this the perforation took place.

Frequency of Occurrence.—That general peritonitis due to a perforation into the free cavity is a rare occurrence the following table of frequency will indicate. No one operator has had many cases, and our ideas of the lesion can only be gained by putting together the single observations of many. Because of the heavy mortality following perforation of the biliary system into the free peritoneal cavity, probably most of the isolated cases have not been reported, so that to gain information as to the relative frequency one must go through the reported series of operations on the biliary system.

	No. of Operations	Cases of Perforation
Adám	112	3
Robson	539	3
Ochsner	48	1
MacLaren	80	4
Kehr	1526	1
Korte	254	7
Jenckel	210	3

	No. of Operations	Cases of Perforation
Ferguson	46	1
Pres Hosp. (McWilliams)	365	6
Totals	3180	29*

Thus we see that the occurrence of perforation into the peritoneal cavity is a very rare accident indeed. There were but 29 cases in 3180 biliary operations. One almost never finds it mentioned in text-books or articles on the differential diagnosis between acute lesions in the upper abdomen. While the lesion is a rare one, it is not so infrequent as one would be led to suppose from the small number of cases published. Are not many of these cases unrecognized? If a calculus completely obstructs the cystic duct, there will be nothing but pus in the gall-bladder with the formation of a purulent peritonitis after perforation, without free bile in the cavity. If there be nothing in the history to call the surgeon's attention to the gall-bladder, there may be nothing found on opening the abdomen in the usual positions to cause one to suspect that the gall-bladder is at fault, and a right diagnosis may not be made until the autopsy table be reached.

Age and Sex of the Patients.—There were 99 patients whose ages are given, and the average age was 50.2 years. The youngest patient was No. 49, whose age was 21 years, while the oldest was No. 44, who was 80 years of age. The disease is one of advanced life as the following statistics show: Between 20 and 30 years: recovered 7, died 2; between 30 and 40 years: recovered 7, died 5; between 40 and 50 years: recovered 14, died 9; between 50 and 60 years: recovered 14, died 21; between 60 and 70 years: recovered 7, died 7; between 70 and 80 years: recovered 4, died 2. Before 50 years there were 44 cases, while there were 55 cases beyond 50 years. Before 50 years there were 63 per cent. of recoveries, while there were but 46 per cent. after 50. How great an influence diseased blood-vessels have upon necrosis and gangrene of the gall-bladder it would be difficult to say.

* Or 0.9 per cent.

The statistics as to sex are as follows: Females: recovered 35, or 56 per cent.; died 27, or 44 per cent.; total 62, or 60 per cent. Males: recovered 19, or 46 per cent.; died 22, or 54 per cent.; total 41, or 40 per cent. From this we find that 60 per cent. of the cases occurred in women and that they stand the disease better than men, the mortality in women being 44 per cent. as against 54 per cent. in men.

Symptoms and Diagnosis.—Peritonitis due to perforation is a most treacherous complication. It may come on during an attack of biliary colic, and as the symptoms in each case are similar (violent pain and vomiting), it may cause serious mistakes. If an attack of colic leaves a very tender gall-bladder region, the patient should be operated upon at once, but if, for any reason, this be not done, then the patient should be very carefully watched. The degree of spread of infection from the gall-bladder is the important point, as judged by the change in the extent of the abdominal rigidity, tenderness, fever, pulse, leucocytes, and polymorphonuclears. All the cases of perforation were ushered in by pain. If a cholecystitis had been present, then the character of the pain changes. From being a more or less dull, continuous localized ache it becomes generalized over a greater extent of the abdomen, down the right side, and to the navel. There may be in some cases at the time of perforation a sense of temporary relief as the tension of the distended gall-bladder is relieved by the fluid effused from its cavity. This is followed by the signs of peritonitis, more extensive rigidity and tenderness, nausea, vomiting, distention, rapid pulse, temperature, and prostration. In some cases perforation is sudden and without warning, and the symptoms are then like those in perforation of a stomach ulcer. More than one patient with perforated biliary system has been operated upon with the diagnosis of perforated gastric ulcer. In this type we find sudden intense pain, which cannot often be localized but is said to spread over the whole abdomen. The patients become rapidly prostrated, collapsed, vomiting soon follows, and the rigid and tender abdomen becomes distended, flatus

ceases to pass, and the pulse becomes rapid and irregular. After a few hours the patient may rally, having the "interval of repose" seen in all forms of perforation within the abdomen.

The tendency of the material which escapes from the gall-bladder is to gravitate downward along the outer side of the ascending colon into the appendical region, which becomes tender and rigid, and at once gives rise to the opinion that one has to deal with a perforated appendix. This is a very frequent mistake in these cases. A careful history and the location of the early symptoms, such as pain and muscular rigidity in the region of the gall-bladder, will enable us often to make a differentiation. A right diagnosis will spare the patient an unnecessary incision and the loss of valuable time with the added danger of opening up protective adhesions. In both my own cases, a wrong diagnosis was made, in one case being due to the inability to get a proper history. A Chinaman (Case I) who spoke no English was operated upon under the diagnosis of perforated appendix, and an appendix incision made. It was not until a large collection of bile was opened into in searching for the appendix that the diagnosis was made of perforated gall-bladder. Thus the gravely infected bile was spread widely, and likely contributed to the fatal outcome, in addition to the added shock of the prolonged operation. The outcome of my second case was more favorable because the infection was not so virulent, due to the earlier operation. The diagnosis was probable intestinal obstruction of unknown origin. On making a Kammerer incision over the appendix, bile at once flowed out and the diagnosis was at once clear. Other diagnoses have been volvulus (Case 81), intestinal obstruction (Cases 18, 24, 91, 97), intussusception (Case 23), intestinal perforation (Case 98), perforated gastric ulcer (Case 47), and appendicitis (Cases 108, 92). One remarkable case is recorded by Kummel, in which a tumor supposed to be ovarian became acutely inflamed, peritonitis followed, with death in two days. The tumor on autopsy was found to be a distended gall-bladder.

The puzzling cases are those in which there is no sudden

large amount of effused fluid, but in which there is a steady small leakage. The pain in these cases is not very great in the beginning if the fluid be not very septic. The diagnosis of intestinal obstruction is apt to be made in these cases, due to the pressure of the collection of bile on the intestines and the paralyzing effect of its contained infection.

In 11 cases it is distinctly stated that jaundice was present at the time of the operation. Of these 6 recovered and 5 died. Its presence indicates an advanced case because, if not present at the time of the perforation, it comes on later from absorption of biliary pigment by the peritoneum.

What a large element infection plays in these cases is shown in the relative mortality of operations for traumatic rupture. Thus Rickets reports 28 cases operated upon for traumatic rupture with 22 recoveries, or 78 per cent.

PROGNOSIS AND RESULTS OF OPERATION.

Duration from Perforation to Operation	Recovered	Died	Per cent. of Recoveries	Per cent. of Deaths
Within 12 hours...	6	1	85.7	14.3
1 day	10	5	66.6	33.3
2 days	7	7	50.0	50.0
3 days	8	8	50.0	50.0
4 days	2	8	20.0	80.0
5 days	3	4	42.8	57.2
6 days	2	2	50.0	50.0
7 days	1	1	50.0	50.0
10 days	2	1	66.6	33.3
11 days	0	1		
14 days	2	0		
Totals	43	38	53.0	47.0

The above table very graphically represents how important it is for these patients with perforation to be operated upon as soon as possible after the perforation. Thus in 7 cases operated upon within 12 hours of the perforation 6 recovered, or 86 per cent.; of 15 cases reported operated upon when the perforation had existed for one day, 10 recovered, or 66 per cent.; of 14 cases operated upon after two days, 7 recovered, or

50 per cent.; of 16 cases operated upon after 3 days, 8 recovered, or 50 per cent. Operations after four days give a very poor prognosis, for in 10 cases only 2 recovered, or 20 per cent. The recoveries then increase, due probably to the fact that the patient has developed his opsonins sufficiently to overcome the infection to a greater extent, for of 7 cases operated upon after 5 days, 3 recovered, or 43 per cent. The sixth and seventh days have each 50 per cent. recoveries.

Of the total number of cases that I have obtained from the literature, 108 in number, 56 recovered, or 51.8 per cent., while 52 died, or 48.2 per cent. Rickets reported 160 cases which were not operated upon and of this number but 6 recovered, or only 3.7 per cent. We may say then that without operation a patient with a spontaneous perforation of the biliary system is in a hopeless condition, and even with operation nearly half the patients will die.

Treatment.—Prevention is the key-note in modern medicine. As Korte has said, "To prevent perforation, one should immediately operate when one finds a greatly distended and sensitive gall-bladder with peritoneal irritation." The custom is fairly general of waiting for the disappearance of infectious symptoms in a frank case of cholecystitis. Most of these symptoms will subside and then there is hesitation about operating until another attack occurs. Each attack produces its effect in changing the pathology of the gall-ducts, rendering a subsequent operation more serious for the surgeon and for the patient. In any attack the stretched biliary system may rupture, producing either a local or general peritonitis and rendering an immediate operation imperative.

Perhaps in no acute condition in the abdomen is one compelled to exercise so much judgment at the time of operation as in these perforations into the peritoneal cavity. He who is the keenest observer of the conditions found in the abdomen, who can best estimate the virulence of the infection present, the degree of adhesions, and the pathological conditions present in the gall-bladder system, who can make a good mental estimate of how much or how little the patient can stand

who can get in and get out of the abdomen the quickest, inflicting the least possible trauma, will have the greatest success in these trying cases.

The age of the patient must be taken into account in considering what had best be done. Of 100 patients with perforation into the peritoneal cavity, over 56 per cent. occurred in persons over 50 years of age. These elderly persons do not stand infections of their peritoneum well, for 63 per cent. of patients under 50 recovered, while but 46 per cent. of those over 50 years got well. Everything should be done to minimize shock in these elderly persons.

The old question of cholecystostomy *versus* cholecystectomy is naturally one which must be quickly decided upon as the operation proceeds and the conditions are revealed. I have endeavored to get some light on this question from analyzing the reported cases. If we take the cases which were operated upon within 24 hours of the perforation, there does not seem to be a great deal in favor of one procedure over the other, although the cases are too few to draw any very definite conclusions. This is what one would expect because in these early cases one will find few adhesions, and in order to do an ectomy, one would open comparatively few fresh avenues for spread of the infection. Thus, 20 cases were operated upon within 24 hours after perforation: cholecystostomy: recovered 11 or 68 per cent; died 5 or 32 per cent.; cholecystectomy: recovered 3 or 75 per cent.; died 1 or 25 per cent. From this we might argue that the balance is in favor of an ectomy in these early cases.

The operative measures in general which have been used in treating these cases, taken as a whole, are as follows with the results: (1) suture of perforation with drainage of peritoneum: recovered 1 or 20 per cent.; died 4 or 80 per cent.; (2) tamponade of the biliary region: recovered 10 or 47 per cent.; died 11 or 53 per cent.; (3) cholecystostomy: recovered 30 or 61 per cent.; died 19 or 39 per cent.; (4) cholecystectomy: recovered 16 or 48 per cent.; died 17 or 52 per cent.

Suture of the perforation needs merely to be mentioned to

be condemned, as it violates all our modern ideas of the treatment of biliary diseases.

Simple incision of the abdomen with drainage of the biliary region gave 47 per cent. of recoveries. Cholecystectomy accomplished very little more, 48 per cent. recovering. The best results were obtained with cholecystostomy with which 61 per cent. recovered. Many of the cases with simple incision were in desperate condition, and the gravity of the general state seemed to contraindicate further measures. It is a question open to discussion how much better results would have been obtained had a better means of drainage been provided, in some of the cases. Thus, the case of Korte (No. 31), which died on the eighteenth day, that of Hawkes (No. 95), which died on the twenty-first day after operation, and of others, brings up the question of whether an intervention more direct to the seat of infection with the drainage of the infected bile to the surface would not give better results. Each operator will have to decide this question for himself in each individual case.

How does it stand with cholecystostomy *versus* cholecystectomy? On first sight one is struck with the success of the former as compared with the latter, 61 per cent. of recoveries with cholecystostomy as against 48 per cent. with cholecystectomy. Cholecystostomy for the average operator is the less dangerous procedure, and should therefore be preferred in these perforative cases. But are there exceptions and, if so, what are they? Cholecystostomy has given brilliant results in some apparently hopeless cases, such as those of Korte, Kummel, Lecene, Mosetig-Moorhof, Thiel, Jaboulay, Whitacre, and others. In other cases the outcome has been such as to suppose that cholecystectomy would have been better. Witness the case of Hirschel (No. 16) who did a cholecystostomy in a patient with acute cholecystitis with gangrene of the neck of the bladder. At first he recovered, but died on the twelfth day of pulmonary gangrene. The same occurrence took place in a patient of Narath (No. 80) on the tenth day. Also the patient of Hartig (No. 12) who

had scarcely left the hospital after a cholecystostomy before he had a second perforation of his gall-bladder with a second operation, as a result of which he succumbed. Whitacre's case (No. 86) had two perforations at different times with two different operations with a successful outcome. These secondary ill-results would likely have been avoided by a primary cholecystectomy. The cases with pulmonary gangrene probably had their origin in a persistence of the focus of infection in the bladder gangrene. As a rule, then, we are justified in saying that cholecystostomy should be the operation of choice in cases in which there is little sepsis. In cases, however, where there is a severe infectious cholecystitis with an ulcerative or gangrenous process, *i.e.*, the grave cases, it were better to remove the focus by a cholecystectomy where this is possible. By this means some of the infecting process will be removed. A drain should always, however, be placed in the stump of the cystic duct, and the peritoneum also be drained. Adhesions should not, however, be broken up to accomplish this except to a slight degree. Should bile be free in the abdomen, it would be well to flush the whole cavity quickly with salt solution and to place a drain possibly in the suprapubic area. Nothing by mouth for a few days (the Ochsner treatment), salt solution by rectum according to Murphy continuously, colon irrigations, and the Fowler position should constitute the after-treatment. Gall-stones should be removed at the time of the operation, and in draining, it should be borne in mind that the right kidney pouch forms a distinct peritoneal pocket and that a drainage tube applied through a stab opening in the right loin affords a free exit for extravasated fluids coming from the neighborhood of the gall-bladder.

There is great difference of opinion as to the wisdom of performing a cholecystectomy in these perforative cases. Summers (ANNALS OF SURGERY, July, 1911), says: "All infections of the gall-bladder, empyema, gangrene, should be treated by simple incision and drainage after a protective gauze packing off of the peritoneal cavity. I have known

disaster follow cholecystectomy in such cases—the crushing of the cystic duct and its artery, more especially of the poison laden lymphatics; the trauma to the peritoneum passing from the gall-bladder neck to the gastrohepatic omentum can and does in some instances lead to a thrombophlebitis and fatal infections. By free incision into the gall-bladder, gangrene will probably not extend and tension will be relieved." Robson ("Gall-Stones," 1909, p. 161) regarding perforative cases remarks: "Should marked cholecystitis be found, the question of cholecystectomy may be worth considering; but when the patient is in a critical condition, it is a mistake to attempt too much, and, as a rule, cleansing and free drainage will be all that are necessary or advisable at the time, the removal of the cause being left until the patient is better able to bear a more prolonged operation." Moynihan writes regarding the treatment of perforative cases ("Gall-stones and their Surgical Treatment," 1905, p. 279): "In all probability cholecystectomy followed by free drainage will prove to be the safest method of treatment." Cotte and Arnaud say (*Revue de Chirurgie,* March, 1911, p. 358): "In all biliary perforations without a concomitant grave infectious state, one can in general content himself with making a simple drainage of the biliary system. In the grave forms, on the contrary, which result from an active process of ulceration or of gangrene, every time that the situation permits it, one should prefer the ablation of the gall-bladder." Mayo, in Keen's "Surgery," vol. iii, says regarding perforations of the gall-bladder: "The treatment should be immediate abdominal section for the removal of the gall-bladder and free drainage."

CONCLUSIONS.

1. In 3180 operations on the biliary system, acute spontaneous perforation into the free peritoneal cavity occurred 29 times, or 0.9 per cent. It is thus a very rare accident.

2. In 90 cases of perforation, 82 of them, or 91 per cent., occurred in the gall-bladder, 3, or 3.3 per cent., perforated through the cystic duct, 4, or 4.4 per cent., through the com-

mon duct, while but 1, or 1.1 per cent., perforated through the hepatic duct.

3. Calculi are a great factor in causing perforation, for in 80 out of 108 cases, or 74 per cent., stones were found at the time of the operations. In 14 cases, or 13 per cent., it was found that no stones were present after adequate search. In the 14 remaining cases, or 13 per cent., stones may or may not have been present as no mention is made of them.

4. In but 9 cases is it distinctly stated that gangrene was present.

5. Of 99 patients whose ages are given, the average was 50 years. Before 50 years, there were 44 cases with 63 per cent. of recoveries, while beyond 50 years there were 55 cases with 46 per cent. of recoveries. Between 50 and 60 years, there were 35 cases with but 14 recoveries.

6. Sixty-two of the cases occurred in women, or 60 per cent., and they stand the disease better than men, the mortality in women being 44 per cent. as against 54 per cent. in men.

7. Of 108 cases operated upon, 56 recovered, or 51 per cent., while 52 died, or 48 per cent. This is in contrast to the 28 traumatic ruptures, reported by Rickets, operated upon with 22 recoveries, or 78 per cent. The difference is due to infection.

8. Early operation, as in all forms of peritonitis, is the best guarantee of success; thus, of 7 cases operated upon within 12 hours of the perforation 6, or 85 per cent. recovered; of 15 operated upon within one day of the perforation, 10, or 66 per cent. recovered; of 14 within 2 days, 7 recovered, or 50 per cent.; of 16 operated upon within 3 days of the perforation, 8 recovered, or 50 per cent.; while of 10 cases that had gone 4 days before operation only 2 recovered, or 20 per cent.

9. Suture of the perforation is to be unhesitatingly condemned. Four out of 5 cases thus treated died. Simple incision of the abdomen with drainage of the biliary region gave 47 per cent of recoveries. With cholecystectomy 48

per cent. recovered. The best results were obtained with cholecystostomy, with which 61 per cent. recovered.

ABSTRACT OF 108 CASES OF BILIARY PERFORATION FROM LITERATURE.

Case 1 (Von Arx): Female, 48; colics for 2 months, acute for 20 hours; perforation at neck, free bile. Suture of perforation. Cholecystostomy. Recovered. One calculus in gall-bladder.

Case 2 (Baldwin): Female, 50; colics for years, symptoms for one day; perforation in body, free bile. Cholecystostomy. Recovered. Six calculi in gall-bladder.

Case 3 (Baldwin): Male, 55; indefinite colics four days; perforation in body, gangrene. Cholecystectomy. Died. Several calculi in gall-bladder.

Case 4 (Baldwin): Male, 27; symptoms three years, colic two days; perforation in fundus, extensive adhesions. Cholecystectomy. Recovered. Twelve calculi in gall-bladder.

Case 5 (Brunner): Female, 56; symptoms one year, colics not stated; perforation of hepatic duct, abdomen full of bile. Tamponade only of abdomen. Died. Stone in ampulla and two in common duct.

Case 6 (Brunner): Female, 50; stomach symptoms 24 hours; gall-bladder perforated, abdomen full of bile. Cholecystectomy. Died. Calculi in gall-bladder.

Case 7 (Czerny): Female, 61; symptoms five days; perforation of gall-bladder, gangrene; abdomen contained bile. Partial cholecystectomy and suture; abdominal drain. Died. Calculi in gall-bladder.

Case 8 (Delageniere): Perforation of gall-bladder and gangrene. Cholecystectomy. Died. Calculi in gall-bladder.

Case 9 (Finck): Male, 54; symptoms three days; perforation of gall-bladder. Tamponade only. Recovered.

Case 10 (Hallet): Female, 45; colics one day; perforation of gall-bladder. Cholecystostomy. Recovered. Four calculi free.

Case 11 (Hallet): Female, 50; colics fifteen hours; pressure perforation at fundus, free bile. Cholecystostomy. Recovered. Numerous calculi in gall-bladder.

Case 12 (Hartig): Female, 42; symptoms four days; perforation of gall-bladder twice, free bile. Cholecystostomy twice. Died. Calculus in gall-bladder. Two operations.

Case 13 (Hartig): Male, 62; previous colics; perforation of gall-bladder, free bile. Cholecystostomy. Recovered. Perforation over calculus.

Case 14 (Hartig): Female, 53; symptoms six days; perforation in fundus, adhesions. Cholecystectomy. Died. Three calculi in gall-bladder.

Case 15 (Hirschel): Female, 27; symptoms two days; perforation in fundus, localized. Cholecystostomy. Died. Several great calculi.

Case 16 (Hirschel): Male, 57; symptoms four days; perforation near neck by pressure. Cholecystostomy. Died. Single calculus; pulmonary gangrene on eleventh day.

Case 17 (Hirschel): Female, 59; perforation; suture of perforation. Died. Stones not stated; death from pneumonia.

Case 18 (Hochenegg): Female, 45; symptoms 12 hours; perforation at middle; suture of perforation. Cholecystostomy. Recovered. Diagnosis, intestinal obstruction; stones present.

Case 19 (Jaboulay): Male, 66; symptoms two years, colics three days; perforation. Cholecystostomy. Died. One calculus; great.

Case 20 (Jenckel): Female, 45; symptoms three days; perforation at summit. Tamponade only. Died. Stone not stated.

Case 21 (Aurray): Female, 48; symptoms 12 hours; perforation of neck. Suture of perforation. Died. General peritonitis; stones present; no jaundice.

Case 22 (Kehr): Female, 51; symptoms four days; perforation of common duct. Cholecystectomy. Died. Calculi in common and hepatic ducts; perforation of common duct; jaundice.

Case 23 (Konig): Female, 70; symptoms two days; perforation by pressure of gall-bladder. Cholecystectomy. Recovered. Diagnosis, invagination of intestines; calculi numerous.

Case 24 (Korte): Male, 56; colics five days; several perforations in gall-bladder. Cholecystectomy. Recovered. Diagnosis, intestinal obstruction; large calculus; intestinal cavity washed.

Case 25 (Korte): Female, 37; colics three days; several perforations in gall-bladder. Cholecystostomy. Recovered. Calculi present; no jaundice.

Case 26 (Korte): Female, 30; colics three days; perforation of gall-bladder. Cholecystectomy. Recovered. Calculi at entrance of cystic duct.

Case 27 (Korte): Female, 72; perforation of gall-bladder. Cholecystostomy. Recovered. Several calculi; secondary ectomy two months later.

Case 28 (Korte): Female, 63; symptoms four days; perforation of gall-bladder. Cholecystectomy. Died four weeks after operation of embolism; one calculus.

Case 29 (Korte): Female, 51; perforation of cystic duct; drainage in common duct, also cystic duct. Cholecystostomy. Died. Calculi in common and hepatic duct. None in gall-bladder.

Case 30 (Korte): Male, 30; symptoms five days. Tamponade, incision only. Died. Stones not mentioned.

Case 31 (Korte): Female, 56; symptoms five days; perforation of gall-bladder. Tamponade, incision only. Died on eighteenth day after operation.

Case 32 (Kummel-Goldammer): Male, 57; symptoms two days; perforation of fundus, free bile. Cholecystostomy. Died. Calculi present.

Case 33 (Kummel-Goldammer): Female; symptoms three days; free bile. Cholecystostomy. Died. Calculi present; death after a number of days.

Case 34 (Kummel-Kammerer): Female, 33; gangrene with perforation. Cholecystostomy. Recovered. Calculi present.

Case 35 (Kummel-Kammerer): Male, 65; gangrene with perforation. Cholecystostomy. Died. Calculi present.

Case 36 (Kummel-Goldammer): Male, 54; gangrene with perforations. Died.

Case 37 (Kummel-Goldammer): Female, 50; symptoms two days; empyema and perforation. Died. Numerous calculi.

Case 38 (Kuster): Female, 57; symptoms 28 hours; perforation from pressure of calculi. Closure of perforation. Died. Calculi present.

Case 39 (Lecene): Female, 62; symptoms three days; perforation at fundus. Cholecystostomy. Recovered. Single calculus; second operation two months later; cholecystectomy.

Case 40 (Maire): Male, 36; symptoms ten days; perforation of gall-bladder, free bile. Cholecystectomy. Died. Icterus present; cholecystitis; calculus in ampulla removed; hepaticus drainage.

Case 41 (Martens): Female, 58; symptoms three days; perforation of cystic duct, gangrene from pressure. Cholecystectomy. Died from pneumonia; calculi present.

Case 42 (Marwedel): Female, 27; symptoms two days; perforation of gall-bladder. Cholecystostomy. Died. Numerous calculi.

Case 43 (Meriwether): Female, 62; symptoms one day; perforation of gall-bladder by pressure. Cholecystostomy. Recovered. No calculi.

Case 44 (Meriwether): Male, 80; symptoms five days; perforation of gall-bladder. Tamponade only. Died. Numerous calculi.

Case 45 (Von Mosetig-Moorhof): Male, 59; symptoms four days; perforation of gall-bladder at fundus. Cholecystostomy. Recovered. Several calculi.

Case 46 (Neck): Female, 43; symptoms three days; perforation of gall-bladder at summit. Cholecystostomy. Recovered. Numerous calculi.

Case 47 (Newbolt): Female, 48; symptoms two days; perforation of gall-bladder; gangrene; suture of perforation and of abdomen. Died. Stones removed; one impacted in cystic duct. Diagnosis, perforation of gastric ulcer; no jaundice.

Case 48 (Nordmann): Female, 49; tamponade only. Recovered. Stones not stated.

Case 49 (Nordmann): Female, 21; symptoms one day; perforation of gall-bladder, free bile. Cholecystectomy. Recovered. Drainage of common duct; numerous stones; numerous abscesses in gall-bladder wall.

Case 50 (Riedel): Female, 74; symptoms 36 hours; perforation of fundus. Cholecystectomy. Died. Single large stone in neck.

Case 51 (Riedel): Female, 55; symptoms seven days; perforation at fundus. Cholecystectomy. Died. Numerous calculi.

Case 52 (Riedel): Male, 56; symptoms three days; perforation of gall-bladder and of common duct. Cholecystostomy. Died. Pigeon's egg calculus in common duct; hepatic drainage, also Douglas.

Case 53 (Routier): Female, 56; symptoms one day; perforation of common duct, free bile. Cholecystostomy. Recovered. Numerous stones, secondary ectomy.

Case 54 (Schnitzler): Female, 55; symptoms five days; perforation of gall-bladder, gangrene. Cholecystectomy. Recovered. One stone; jaundice.

Case 55 (Schonborn): Female, 50; symptoms three days; abdomen alone drained, free bile. Tamponade of abdomen only. Recovered. No stones found.

Case 56 (Straetter): Female, 63; symptoms five days; perforation of gall-bladder. Cholecystostomy. Recovered. Numerous stones.

Case 57 (Thiel): Female, 59; symptoms three days; perforation of fundus. Cholecystostomy. Recovered. One large stone.

Case 58 (Torrance): Male, 59; symptoms four hours; perforation of gall-bladder, free bile. Cholecystectomy. Recovered. Gastro-enterostomy, appendectomy; stones not stated.

Case 59 (Ullmann): Male, 42; symptoms six days; perforation from pressure of stone in gall-bladder. Cholecystectomy. Died. Numerous calculi, one in cystic duct; no jaundice.

Case 60 (Ullmann): Female, 53; symptoms twelve hours; perforation of gall-bladder, free bile. Tamponade only. Recovered. Numerous stones; no jaundice.

Case 61 (Verral): Female, 44; symptoms four days; perforation of fundus; suture of gall-bladder. Recovered. Numerous calculi.

Case 62 (Villard): Female, 35; symptoms three days; perforation of gall-bladder. Tamponade only. Died. Numerous calculi.

Case 63 (Weigel): Male, 45; symptoms one day; perforation of fundus, free bile. Cholecystostomy. Died. Calculi removed from cystic duct and gall-bladder.

Case 64 (MacLaren, Case III): Male, 50; symptoms ten days; perforation on anterior wall. Cholecystostomy. Recovered. No stones.

Case 65 (Vaughan): Male; symptoms three days; perforation of gall-bladder; drainage of abdomen only. Died. No stones; developed during typhoid and operation for supposed perforation.

Case 66 (Rixford): Male; symptoms two days; perforation at fundus. Cholecystectomy. Recovered. Aseptic perforation; numerous calculi in gall-bladder.

Case 67 (Haggard): Male; perforation of gall-bladder. Drainage of abdomen only. Recovered. Stones free in abdomen.

Case 68 (Moynihan): Male, 46; symptoms eleven days; perforation at fundus, free bile. Cholecystostomy. Died. Seven stones in gall-bladder.

Case 69 (Walker): Male, 27; symptoms three days; perforation at fundus by pressure, free bile. Cholecystectomy. Recovered. Numerous stones; one large one by pressure caused perforation.

Case 70 (MacLaren, Case VIII): Male, 45; symptoms two weeks; perforation at fundus; enormous abscess with bile. Cholecystostomy. Recovered. Stones removed at secondary operation; subdiaphragmatic abscess opened; jaundice present.

Case 71 (MacLaren, Case IX): Female, 31; symptoms ten days; perforation at fundus; large abscess and stones. Tamponade only. Recovered. Jaundice.

Case 72 (MacLaren, Case X): Female, 32; large abscess with stones.

Cholecystostomy. Recovered. Followed on typhoid; secondary cholecystostomy with removal of stones.

Case 73 (Ferguson): Female, 35; perforation at fundus, free bile. Cholecystostomy. Recovered. Several stones; jaundiced.

Case 74 (Noetzel): Male, 52. Cholecystectomy. Died. Stones not stated.

Case 75 (Noetzel): Male, 63. Cholecystectomy. Died. Stones not stated.

Case 76 (Noetzel): Female, 62. Cholecystectomy. Died. Stones not stated.

Case 77 (Noetzel): Female, 65. Cholecystectomy. Recovered. Stones present.

Case 78 (Noetzel): Female, 59. Cholecystectomy. Died. Stones not stated.

Case 70 (Noetzel): Female, 23. Cholecystectomy. Recovered. Single stone present.

Case 80 (Narath): Male, 59; symptoms four days; perforation of gangrenous spot, free bile. Cholecystostomy. Died from pulmonary gangrene. One stone in gall-bladder.

Case 81 (Kranze): Age 67; symptoms two days; perforation at fundus, free bile. Cholecystostomy. Recovered. Diagnosis before operation, volvulus; no stones.

Case 82 (Kranze): Age 70; symptoms six days; perforation at neck, free bile. Cholecystostomy. Recovered. No stones.

Case 83 (Neupert): Female, 42; symptoms 14 hours; perforation of common duct at juncture with cystic duct, free bile. Cholecystectomy. Recovered. Jaundice; acute impaction of stone in common duct. Removed.

Case 84 (Whitacre): Male, 72; symptoms 12 hours; no stones; perforation of gall-bladder, free bile. Cholecystostomy. Recovered. No stones; no jaundice.

Case 85 (Whitacre): Female, 42; symptoms one week; fundus perforated, free bile. Cholecystostomy. Recovered. Many stones in gall-bladder; no jaundice.

Case 86 (Whitacre): Female, 26; first operation 24 hours, second operation 27 hours; perforation in fundus, free bile. Tamponade only in both operations. Recovered. Three operations; two first were cholecystostomies, third was cholecystectomy; two perforations at different times; gallstones present in gall-bladder; jaundice not mentioned.

Case 87 (Whitacre): Male, 58; symptoms two days; perforation in fundus, free bile. Cholecystostomy. Recovered. Stones in gall-bladder; no jaundice.

Case 88 (Whitacre): Female, 50; symptoms one day; free bile. Tamponade only. Died. Stones not stated; no jaundice.

Case 89 (Whitacre): Female, 28; symptoms several days; free bile. Tamponade only. Recovered. Stones not stated; no jaundice.

Case 90 (Kiliani): Male, 40; symptoms four weeks; two perforations

in fundus. Cholecystectomy. Died. Two small perforations of ileum found; two stones present.

Case 91 (McWilliams): Male, 67; symptoms one day; perforation in fundus, immense pocket of bile. Cholecystostomy. Recovered. Diagnosis, intestinal obstruction or appendicitis; two incisions; no jaundice; stone removed.

Case 92 (McWilliams): Male, 38; symptoms three days; perforation of cystic duct. Cholecystostomy. Died. Diagnosis, appendicitis; two incisions; stone present.

Case 93 (Dr. Brown): Male, 49; symptoms two weeks; perforation at fundus. Cholecystostomy. Recovered. One stone removed.

Case 94 (Dr. Blake): Male, 49; symptoms two days; perforation at fundus, no adhesions, free pus. Cholecystectomy. Recovered. Many stones; general abdominal irrigation.

Case 95 (Dr. Hawkes): Male, 31; symptoms four days; large abscess, adhesions. Tamponade only. Died twenty-one days after operation. No stones; jaundice present.

Case 96 (Dr. McCosh): Male, 26; adhesions about gall-bladder, gangrene, bile, and pus. Cholecystectomy. Recovered. No stones; jaundice present.

Case 97 (Roersch): Female, 67; symptoms one day; perforation of gall-bladder, free bile. Cholecystostomy. Died. Operation for intestinal obstruction; single stone present.

Case 98 (Erdmann): Female, 46; symptoms 12 hours; perforation of gall-bladder, free bile. Cholecystostomy. Recovered. Diagnosis, intestinal perforation; stones present in gall-bladder; typhoid present.

Case 99 (Jopson): Female, 51; symptoms 72 hours; perforation not located, free bile. Cholecystostomy. Recovered. Stone impacted in cystic duct; jaundice present.

Case 100 (Fritz-Koenig): Female, 70; symptoms two days; perforation at fundus. Cholecystectomy. Recovered. Numerous stones; jaundice.

Case 101 (Williams and Sheidd): Male, 31; perforation of gall-bladder. Tamponade only. Recovered. During typhoid, no stones.

Case 102 (Adám): Female; perforation of gall-bladder. Cholecystostomy. Died. Stones not mentioned.

Case 103 (Adám): Cholecystostomy. Died. Stones not mentioned; jaundice present.

Case 104 (Adám): Cholecystostomy. Died. Stones not present; jaundice present.

Case 105 (Mayo-Robson): Male, 45; several pints of bile and pus. Cholecystostomy. Recovered. Stones not mentioned.

Case 106 (Mayo-Robson): Female, 47; symptoms six days; perforation of fundus. Cholecystectomy. Recovered. Several stones removed; deeply jaundiced.

Case 107 (Gordon): Male, 50; symptoms four days. Tamponade only. Died. Calculi present; jaundice present.

Case 108 (Grant): Male, 53; symptoms 15 hours; quart of bile. Tamponade only. Died. Diagnosis, appendicitis; no stones; no jaundice.

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THE ERROR OF OVERLOOKING URETERAL OR RENAL STONE UNDER THE DIAGNOSIS OF APPENDICITIS.

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THE diagnosis of appendicitis, after the enormous experience of the past twenty-five years, admits of little if any improvement either in method or in results. Occasionally, nevertheless, I meet with considerable difficulty in recognizing appendicitis with accuracy, or differentiating it from other rare lesions that may closely resemble it. The more I see of this disease, the more I am impressed by my ignorance of it. I cannot help recalling the positive conclusions to which I came after my first five cases. Indeed, now that my cases have risen into the thousands, I find that facts of great importance, especially in connection with the diagnosis, are constantly coming out—facts that in the beginning were never even suspected. Moreover, judging by the post-operative and unbenefited cases that come to me with symptoms and complications which the operator had apparently never suspected or understood, I feel that there may be others beside myself who occasionally overlook the real cause of symptoms and complications. For example, I may mention a left-sided tuberculosis (so it was diagnosticated, operated upon, and abandoned, in Manitoba), which proved to be a chronic appendicitis following an acute perforative localized peritonitis. The patient was cured by removal of a thickened, scarred, and cheesy appendix.

In another case—that of a young man—I found a much-diseased appendix causing symptoms and physical signs which made a genito-urinary specialist fear tuberculosis of the blad-

der and a medical internist fear cancer of the lower sigmoid; and yet the diagnostic skill of these men was of the highest, and their experience of the broadest. I had the same fears, but felt a strong hope that the lesion was an unusual form of appendicitis. This proved to be the case, and removal of the appendix restored the patient to health. Not a few instances have come to my attention in which similar error has occurred, and I have no doubt that others have been able to make in my cases, abandoned as hopeless and inoperable, an occasional brilliant diagnosis of the real condition of the appendix, and to accomplish complete operative cure.

A very puzzling case was one in which, under the diagnosis of appendicitis (which was correct), operation had been undertaken and abandoned. The operator could not find the appendix. Some months later, as the symptoms continued, I undertook the operation in a confident spirit, only to find myself searching in vain for the appendix through the right half of the abdomen. As there was no cæcum in the right iliac fossa, I carried my incision high enough to explore the region of the gall-bladder, duodenum, and right kidney; but no sign of cæcum or appendix could there be found. My assistant finally observed that the sigmoid flexure started in the right iliac fossa, that, in fact, the viscera were transposed, and that the appendix was in the left iliac fossa, easily accessible through the unusually long incision that I had made.

I will not speak of cases of salpingitis, ovarian tumor with twisted pedicle, extra-uterine pregnancy, cancer of the ileocæcal valve, tuberculosis of the cæcum, psoas abscess, perforation of the stomach or duodenum, strictures of the duodenum or jejunum from unsuspected malignant disease, gallstones, and cholecystitis, as well as many other organic lesions that I have mistaken for appendicitis. My subject—stone impacted in the right ureter and simulating appendicitis so that the operator has been deceived—seems to me, from its frequency and from the ease with which the truth may be demonstrated, worthy of special consideration.

The number of my cases in which appendicitis has been

mistaken for a urinary calculus or a urinary calculus mistaken for appendicitis is not large, including the cases operated upon and unoperated upon, in the diagnosis of which a successful differentiation was made before operation. I have collected them all for this paper; but I may not have recognized all there were. In several the surgeon who removed the appendix never knew that the symptoms were due to ureteral calculus, and in some of my own I was at first deceived. How many cases I have operated on by taking out the appendix, with recovery from the operation and synchronous subsidence of ureteral symptoms, I do not know. I dare say that there have been several, judging from the frequency of ureteral stones in my cases since I began systematic search for them. Judging from some of the cases, a stone impacted in the ureter may stay there indefinitely, without any symptoms whatever, after subsidence of those of the original attack. That I have had at least one case like this I know; that there have been others, operated upon and unoperated upon, without knowledge of the true pathology, I am quite prepared to believe.

One object of this paper is to show how easily one may be deceived; another is to show how easily one may escape error.

I look upon the multiplication of appendectomies with complacency, and without any especial objection beyond that of inadequate indications for even this, one of the safest of operations. Except in the highly imaginative and neurasthenic, I do not think unnecessary appendectomy is likely to do any harm in the hands of those well fitted to perform abdominal operations. The *furor operandi*, a few years ago directed against the ovary, has been transferred to the appendix. But in the efforts to find and remedy the cause of abdominal pain, removal of an apparently normal appendix is attended with many beneficent results. I have no doubt whatever that many appendices apparently normal are really dangerous to health and life. How many serious attacks of appendicitis and peritonitis have been prevented by the numerous appendectomies, there is no means of telling. That

pain, discomfort, and fever are permanently relieved, I know. I am beginning to see the benefits of normal appendectomies performed in the course of other abdominal operations, for in several cases other causes for peritonitis have been recognized, in the known absence of an appendicular cause. Furthermore, in the case of several patients I have been obliged to operate for acute appendicitis because I had not removed the appendix when it could have been removed easily and safely during some previous abdominal operation for other lesions.

It is the wide-spread belief in the value of appendectomy that makes us perhaps careless in our indications, and especially that indication which rests upon an accurate diagnosis. If we say that in the hands of good surgeons removal of the appendix is likely to do the greatest amount of good at the least exposure of danger and suffering, I admit the truth of this statement, but only when, by the elimination of other causes of pain and discomfort, we are as sure as we can be that we are not mistaking for an appendicular cause some other and more serious disease.

I am about to consider the ureteral stone as a not infrequent "other cause"; but there are, I am sure, many other lesions which are and will be overlooked unless we search diligently for them.

My most recent illustration of these remarks—not twenty-four hours before these words were written—is the case of a girl of three, with menacing symptoms of intestinal obstruction. A year ago a surgeon, operating for abdominal symptoms diagnosticated by the highest authority as appendicitis with abscess, found a slightly affected appendix, without abscess, but with a chain of enlarged lymph-glands from the ileocæcal coil to the receptaculum chyli. I found general peritonitis with no cause other than a broken-down gland in the ileocæcal coil. This case shows that the symptoms of appendicitis may arise from inflamed lymph-nodes, and that the previous removal of a prolific cause of peritonitis simplifies much the diagnosis. Its chief application is toward a careful

search for causes other than appendicitis before appendectomy is undertaken.

I wish here to record again my belief and practice in the utmost care in diagnoses upon which depend even trivial operations. Indeed, the safer the operation and the less sure its necessity, the greater the pains to be taken. Abdominal and other operations are performed upon the diagnosis of others; sometimes even upon the patient's own. I have seen too many operations introduced with a remark like this: "The patient is said to have appendicitis. I have not examined her." True, in most instances the operation is necessary; but were all efforts made and precautions taken there would be little occasion to write upon subjects like that of this paper.

A young woman, a stenographer, to whom an operation and its cost were of the utmost importance—much greater than they are in the case of the idle rich—came to me and said: "I am afraid I have appendicitis, and I wish to know. I consulted a surgeon, and said, 'I have pain in my right side and I am afraid I have appendicitis.' He reached over his desk as I sat opposite, touched my side, outside of my clothes, corsets and all, and replied, 'Yes, you have. I will operate in the morning.'" This patient was unwilling to be operated upon after such an examination, and came to me.

It took me a long time to make up my mind in this case, for I had suspicions that the pain might be from a ureteral stone, an ovary, constipation, colitis, movable kidney, or neurasthenia. But, in the end, I came to the same conclusion that the other man did after reaching over his table and touching the girl's dress. I removed an appendix that looked as most slightly offending appendices look. The patient was cured of her pain.

Now, it is in these cases that the rarer causes of abdominal pain are overlooked. Discredit is brought upon surgery; and, worst of all, that discredit is deserved.

The surgeon in his practice is confronted by the greatest possible variety of abdominal pain, especially in women. It

seems to me safe to say that without pain of some sort, at some time, the diagnosis of chronic appendicitis is impossible. It is quite conceivable that an infection of the appendix, the result of an acute process, may exist, quiescent, without pain or even discomfort; but there must have been at some time pain of some kind. The tenderness without pain is much less indicative of an affection of the appendix than pain without tenderness. I often find a tender, appendix-like body slipping under the fingers in the left iliac fossa. Such an object in the right iliac fossa I should unhesitatingly call a tender appendix, and, with pain, deduce an appendicitis. In the left iliac fossa it is of course not the appendix. If anything more than the edge of the colon, muscle border, or tendon or nerve, it may mean a ureteral stone, and this suspicion should indicate an X-ray examination, when, if the tenderness were on the other side, the diagnosis of appendicitis would be reasonably clear. But even on the right side these symptoms should indicate an X-ray search, with or without red blood-cells in the urine. Without some attribute of pain, neither the appendix nor a calculus need receive serious consideration.

When there is real pain without constitutional signs, my suspicions are directed toward a possible urinary stone by paroxysms of more than usual violence. Even when appendicular colic is strongly suspected, intermittence suggests other than an appendicular source of pain. A severity requiring opiates or anything more than external applications, without fever, distention, vomiting, or other signs of beginning peritonitis, suggests stone.

In many of the cases we have no opportunity of judging the pain, for we get only the patient's history of it. In a recent case there were violent recurring attacks so suggestive that I made the diagnosis by the history alone. Dr. Dodd found by X-ray "a stone in the ureter near the bladder."

The kind of pain in chronic appendicitis seems to me to differ from that pain so characteristic of renal colic. To weigh the significance of pain in renal colic, we must go back to its beginning, to the spasm of its first engagement in

the ureter, for the pain of an old impacted stone may be slight. Not so the pain in the early days of impaction. When the stone is first impacted, the pain is so great that words can hardly describe it. Nothing but morphia or general anæsthesia will control it. A stone caught and held immovably in the ureter, indescribable as is at first the agony that it causes, after a few hours or days, like the gall-stone hopelessly impacted in the common duct, no longer causes pain. There may be even no discomfort whatever. The acute spasm, the unbearable agony, are gone; the muscular spasms no longer continue in their original violence.

But there is one physical sign that always arouses or confirms the suspicion of ureteral stone. Blood in the urine, if only microscopic, is a symptom which should always demand an X-ray examination, though I have it made whenever anything in the history, no matter how trivial, arouses the suspicion of stone.

The diagnosis of ureteral stone simulating appendicitis is exceedingly easy and positive. It is made so by the X-ray, without which it could never be made with certainty. True, by ureteral catheterization scratches upon a waxed ureteral bougie, as Kelly suggests, almost prove the presence of a stone. But with the X-ray much more information can be obtained, and without pain or danger. The diagnosis is easy once a stone is suggested or suspected. The stone is overlooked, not because the diagnosis is difficult, but because the presence of the stone is not even suspected.

We all know but we do not always realize the fact that we overlook pathological conditions easy of diagnosis because we do not happen to think of them. The minute the right but overlooked possibility has been suggested, one pounces upon the diagnosis—every symptom in the history and physical examination will fit into and prove that diagnosis.

This statement is particularly true of ureteral stone; the surgeon is so impressed by the truth that he wonders he did not think of it before. The previous history of renal pain or distress, the intermittent attacks, the gradual shift of situa-

tion, the direction of the pain, and last, but most important, blood, even if in microscopic quantities—such symptoms suggest calculus and the X-ray examination. Skilful examinations by experienced X-ray men, controlled by repetitions with a ureteral instrument *in situ,* demonstrate the truth as absolutely as it can be demonstrated in surgical diagnosis.

With such precautions, error in diagnosis, which some years ago seemed to me at times quite unavoidable, is practically beyond serious consideration.

It is not so very important to make out beyond a question the exact diagnosis in acute abdominal emergencies,—at least it is not absolutely essential, because, whatever the pathological lesion may be, the conditions are such that it is without doubt necessary to explore. Not that an accurate diagnosis will not be somewhat of an advantage as guiding the surgeon directly to his lesion; but in emergencies, time is always of such great importance that to spend it in attempting the impossible, when a stroke of the knife will make the diagnosis sure, is the worst of folly.

And yet there have doubtless been many unnecessary and perhaps fatal explorations which a little more careful study of the cases might have prevented: appendectomies and other explorations in typhoid fever; search for acute lesions that did not exist, such, for example, as the search for the cause of intestinal obstruction in the obstipation and pain of lead colic; search for blood when there was no blood; operation for extra-uterine pregnancy when the pregnancy was normal. There has been search throughout the left upper quadrant when the lesion was in the right lower; search for a mechanical cause of intestinal obstruction when there was the *ileus paralyticus* of peritonitis; for duodenal ulcer in cancer of the jejunum; for gall-stones in pancreatitis; for a host of possible lesions remote from a simple gangrenous appendicitis,—in a word, search everywhere but in the right place.

Scattered through my records are cases illustrative of all these things. In explorations shown to be unnecessary—in spite of that fact—the results have been recovery from the

exploration, and, in many cases, perhaps through the suggestive effect of the operation *per se,* the patient has been restored to health. When really serious lesions have been found, but only after prolonged search, that loss of time has always added to the danger and increased the mortality. In most emergencies, however desirable the exact diagnosis, there is not much time to study the exact pathology. The surgeon should, however, employ the brief time at his disposal to be as accurate as the case and his experience will permit. Errors, whether of diagnosis or of operation, will occur notwithstanding his care. They will not necessarily result from his want of care.

The whole aspect of the question is changed in chronic conditions. Then there is time in abundance to study the patient from every point of view. If diagnosis is humanly possible, then the diagnosis ought to be made, or, if not made, the reason why it is not made should be shown. I, for one, am tired of seeing abdomens opened for one thing when something else is found; and yet no one knows better than I do the limitations of human skill in diagnosis. As I write these words at the Vincent Hospital, are not my assistants putting to bed a woman in whose case I was sure, both before and after anæsthesia, of the diagnosis of uterine fibroid, and from whom I have just taken a tense, adherent, right-sided ovarian tumor? I claim for myself at least an ordinary skill in the interpretation of abdominal symptoms, and in the digital examination. But, as I have said in other papers, there are certain differentiations in abdominal surgery that cannot be made with certainty, and that between the fibroid and certain other pelvic tumors is one of them. We know it and admit it. Therefore, when an error like this is made, we have discounted the limitations. In all error the sting lies in carelessness, heedlessness, ignorance—in failures even to suspect the truth.

I am quite convinced that too little attention is paid to the diagnosis of chronic appendicitis. So long as there is pain or discomfort anywhere near the appendix, chronic organic

disease is diagnosticated and the appendix is removed. I am not opposed to the removal of the appendix when it is diseased; I even favor its removal when apparently normal, if it is easily accessible during other abdominal operations, for I believe that it is a threat to every life, no matter how innocent it looks.

When, however, it is proposed to open the abdomen for the special purpose of seeking and removing the appendix, that is an entirely different matter. Then it is necessary for the surgeon to be as sure as possible that he is on the right track; that it is indeed the appendix that is giving trouble and not some other organ. The exploration is therefore not to be undertaken until all methods of diagnosis are exhausted.

It is here, I believe, that criticism of modern methods is indicated,—I mean the too hasty conclusion that it is always the appendix that is at fault,—criticism of the inadequate history, the superficial examination, the unfulfilled indications for operation.

In my opinion, the less clearly necessary the operation, the more clearly necessary the careful study of the history, physical examination, and contraindications; for the less justifiable the operation, the greater the disaster in case of failure. The greater the haste, the more bitter the repentance. The more neglected the contraindications, the harder to bear the failure.

I am not addressing the occasional operator so much as the expert in abdominal surgery and diagnosis. I have said elsewhere perhaps too much about the wrong done humanity and the science and art of surgery by those who undertake abdominal surgery without adequate preparation for its great difficulties and responsibilities. I do not expect such operators to avoid even the most glaring mistakes, the most disastrous blunders, for they are not qualified either by education or by experience to avoid them.

My first experience of ureteral stone simulating appendicitis occurred some years ago in the practice of a colleague who asked me to see a patient in the next room upon whom

he was operating, and in whom, instead of a chronic appendicitis, he had found a stone impacted in the ureter just above the sacro-iliac synchondrosis. I had never met with this lesion in suspected appendicitis, but soon after a similar experience in my own practice emphasized its possibility. I have been on the lookout for this source of error in chronic appendicitis, and have found in my records two dozen cases more or less, in which the diagnosis of stone in the ureter was made, but in which there was strong doubt as to that diagnosis until it was confirmed either by the X-ray or by operation. In the early cases the diagnosis of stone was strongly suspected, but no stones were found, as no operation was deemed necessary under the diagnosis of acute appendicitis. The patients recovered and were lost sight of. In all the later cases the suspicion of stone led, through X-ray investigation by an expert, to a demonstration which in most instances operation confirmed.

As my records approach the year 1911, the cases under consideration increase. Of the twenty-four (and I have no doubt that several cases have escaped my search) five have been operated on after correct diagnosis, in 1911. The question of ureteral stone has come up in several other cases of suspected appendicitis, but that possibility has been eliminated by the X-ray. The diagnosis of ureteral stone seems, therefore, of considerable practical importance.

In my experience the occurrence of ureteral stone, though not unusual at the present time, is very much more common than it used to be; it is common enough, now that my attention has been directed to the possibility of error, to make me think that in the past I must have overlooked not a few times this cause of abdominal pain, and have removed the appendix without even suspecting the real cause. What became of these cases I do not know; it does not seem likely that all these appendectomies failed to relieve recurring pain without that fact in some way coming to me. It is not because I have written upon the subject that physicians are now sending me cases, for I have published nothing upon it. The reason why

I have found so many cases is that I have looked for them. I remember some years ago, before the X-ray was much used, that I was called to cases of supposed appendicitis which I believed to be cases of renal stone, and upon which I did not operate. One or two patients with pain in the right abdomen under the scar of an appendectomy suggested a ureteral stone. These cases I have not included in this paper, for the diagnosis was not proved. From all my available cases in which the diagnosis is unquestioned, I select a few for illustration.

The first case, briefly abstracted, is that of F. W. A., a physician very familiar with appendicitis, who, with the physician attending him, made a diagnosis of acute appendicitis—a diagnosis that was confirmed by Fitz and myself. This patient I saw on Thursday, February 13, 1908. The first symptom was on Monday, and resembled so much a colic that the patient had had fifteen years before that he supposed it came from the same transitory cause. The pain stayed in the same place all Monday night. It was moderately severe. Morphia hypodermically relieved the pain. The bowels were constipated, and all Tuesday was spent in trying to move them. A profuse movement resulted Tuesday night. Pain became localized in the right groin Tuesday. There were two tender places low down in the right iliac fossa. Both testicles were drawn up. Catheterization was necessary. The pain became agonizing, and morphia had no effect upon it; ether alone controlled it. At the attack twenty years before there was no suspicion of a renal cause. There were two or three attacks of colic in the right side of the abdomen. The attacks came on with vomiting, and would leave for a day or two a soreness in the right side. With the vomiting there would be a sharp pain, so intense as to make him faint. Since then there have been no attacks of colic.

There were signs of local peritonitis at the pelvic brim, perceptible by external and by rectal examination. The temperature was not over 100°. The diagnosis was acute appendicitis of moderate severity, with local peritonitis. The patient decided to await developments, and continued in about the same condition. On February 25 the local signs were much less, and the patient very comfortable. The temperature dropped to 99°.

In this case we felt sure of an appendicular origin, but there was a suggestion of renal colic in the history, which, in spite of the local signs in the right iliac fossa, led to an X-ray examination as soon as the patient could leave his bed. A shadow about the size of an almond was found at the level of the sacro-iliac synchondrosis. The advisability of searching for the stone, after proving the diagnosis by ureteral catheterization, was considered, but the patient, wisely, as the event proved, decided to await developments. His view of the case is shown by a letter written three years later (in August, 1911): "I am practically free from disturbances of any kind. An occasional grumble in the abdomen is almost always proven to be intestinal in origin. There is no tenderness over the site of the stone; absolutely no bladder or urinary symptoms of any kind. Micturition is normal in quantity and frequency, and the urine is negative to examination. I weigh 205 pounds; rode in the automobile last year 13,500 miles, over all sorts of roads, with no disturbance or trouble. The last radiograph was taken over a year ago. At that time there was practically no change in the position or size of the calculus. As I look back it is my belief that this calculus has existed in its present location for over twenty years."

This case is used to illustrate the error of diagnosis rather than the treatment of ureteral stone. It is interesting to see that the stone remained thus impacted without causing disability of any kind. One cannot hope, however, often to see so fortunate an ending.

A somewhat similar case is that of Mrs. S., aged forty-five, who was taken suddenly on Saturday with pain in the abdomen, followed by distention. There had been constipation for four days. With the pain and distention there was vomiting. On Sunday the pulse and temperature were up a little. Monday morning the temperature was 102°; at night 103°. At no time was there any rigidity in the right side. A mass could be felt in the right lower quadrant; it could be outlined very accurately by bimanual examination. In this case the diagnosis lay between appendicitis with abscess and pyosalpinx. There had never been any abdominal symptoms before. There was no loss of weight. In the diagnosis appendicitis, salpingitis, inflamed ovarian cyst,

cyst with twisted pedicle, extra-uterine pregnancy, and some complication of a fibroid were considered. Operation showed a localized peritonitis with abscess at the brim of the pelvis and extending to the uterus and bladder on the right side. The patient made a good recovery. After the operation a sinus persisted. Some two or three months later with a probe I felt a very hard, gritty stone. This I removed with difficulty. The stone looked very much like a ureteral stone. I went over the history of this patient again with the greatest care to see if any signs of an impacted stone could be found. I never was able to determine positively whether this stone was of intestinal or of urinary origin. I always felt that it was of renal origin. It was arranged in concentric layers. It seemed to me that this stone had been impacted in the ureter and that all the symptoms and the abscess were the result of it. I never had any positive proof of its origin. The patient would never submit to an X-ray examination. There were no signs in the urine.

This case is of importance in connection with my subject because of the difficulty of telling whether the stone found in the abscess, supposed to be appendicular, was of renal or of intestinal origin. One must not jump to the conclusion when a stone of this kind is found that it has escaped from the ureter. It would have made the course of procedure of extreme doubt had I found the stone at the time of the operation. Unfortunately this patient, an ignorant and timid woman, would not, as I say, consent to an examination which would have proved the diagnosis.

In the case of Miss S., on the other hand, the proof of the renal origin was clear. This patient, twenty-five years of age, had had a severe attack of pain in the right side for which the appendix had been removed. On her way to Boston she was taken with severe pain in the abdomen and went to the Springfield Hospital, where I found her suffering with right-sided pain. She had a temperature of 101° and a pulse of 120. Following this severe attack of pain the X-ray showed a single small stone in the ureter just above the pelvic brim. I explored the ureter at the Springfield Hospital in view of the findings of the X-ray. Instead of finding a stone in the ureter I found a stricture where

the stone may have been, but there was no stone. The kidney felt abnormal. I performed a ureteroplastic operation. The patient did well after this operation but there was leakage of urine. At the time of the operation, neither the patient nor the attending physician was prepared for so severe an operation as nephrectomy. Later the patient came to the Corey Hill Hospital, where a careful study with the X-ray showed stones in the right kidney. A study of the urine showed also suppuration on that side. Cystoscopy and ureteroscopy by Dr. Chute showed no urine coming through the right ureter. I therefore removed the right kidney. The patient made a good recovery and remains well. Dr. Whitney reported "diffuse focal suppurative nephritis."

This case illustrates the error in diagnosis better than any other at my disposal. While it is possible that the appendix may have been diseased and may have required removal, in my opinion the ureteral stone was the cause of the original pain and the appendectomy had no effect whatever. In all the cases of renal and ureteral stone that I have had, the possibility of appendicitis has usually been considered especially if the urinary symptoms have been conspicuous. I have taken special pains to inquire in all cases of renal calculus whether at any time the diagnosis of appendicitis has been made. In many it has been made; in a few the appendix has been removed; and in practically all, appendicitis has been considered only to be eliminated.

In a recent case, that of a man of forty-three, the patient had always felt pain in front and back on the right side in the region of the appendix. There had been no urinary symptoms when the patient first consulted me. The attending physician and I had to consider the possibility of appendicitis before considering seriously stone, but the man was sent to Dr. Dodd, who immediately reported a large stone in the right kidney. In this case and in all cases of this kind without the X-ray one might easily be led to operate unnecessarily upon the appendix, overlooking entirely the possibility of a ureteral or a renal calculus.

Another case in which the possibility of an appendicular origin of right-sided pain was considered but in which early resort to the X-ray, suggested by blood and pus in the urine, made the

truth clear, was that of a man of thirty-eight who for three years had had right-sided abdominal pain. X-ray examination showed a stone which was passed spontaneously until it got impacted near the end of the urethra, whence it was easily removed. Later, pain in the right iliac fossa suggested either appendicitis or a second calculus. X-ray showed a stone a little beyond the pelvic brim. This also was removed.

A similar case was that of a woman of twenty-seven who in April during catamenia was seized with severe pain in the region of the appendix. In May during catamenia she again had in the region of the ovary and appendix, severe pain which lasted several days. There was no blood in the urine. In July she had severe pain with marked tenderness in the appendix region. There was, however, no rigidity or retraction of the abdomen. The pain lasted for four days and gradually subsided. It was so severe that renal stone was suspected, in spite of pain in the region of the appendix and the marked tenderness over the appendix. The urine was carefully watched and finally a little pus and blood were found in it. The radiograph taken in July showed a calculus in the lower portion of the right ureter. This was removed successfully.

One must not forget that the appendix and stone may be coincident. I have two illustrations of this.

In the first case, that of Mr. S., there was, in 1898, a distinct history of renal stone—unmistakable and confirmed by the passage of a stone from the bladder. In July, 1903, there were such unmistakable signs of chronic appendicitis that I removed the appendix. In August, 1903, the patient was taken with an acute cholecystitis while on a vacation in the woods. Dr. Cousins, of Portland, drained the gall-bladder, but a sinus persisted. I finally removed the gall-bladder with the cystic duct, which contained an impacted stone.

A case somewhat like this one was that of Mr. W., of Leominster. There were symptoms of chronic appendicitis; but something in the history suggested a urinary calculus. X-ray by Dr. Dodd showed a stone in the right ureter not far from the bladder. I first removed this stone, which proved to be a phlebolith. The appendix was enlarged and thickened, and contained two or three firm concretions. Following the ureter back to the kidney, I found several calculi in the renal pelvis. While work-

ing at the kidney I could not help noticing that the gall-bladder was full of gall-stones. The patient made a prompt recovery after removal of phlebolith, appendicular concretions, renal stones, and biliary calculi!

In these two cases had there been no urinary calculi found there was abundant evidence of a chronic appendicitis. Nothing called attention to the gall-bladder, however; and the stones at the time of the operation upon the appendix had not caused any symptoms whatever.

The cases which emphasized the error of diagnosis were those in which, after the removal of the appendix, symptoms of pain continued just the same. An appendix scar under which there is pain and tenderness has ever since these early cases suggested at once a ureteral cause. X-ray has shown that cause to be in fact present.[1]

A final case illustrates appendicitis in which the pain simulates that of renal stone.

A girl of nineteen, a stenographer, for a year had recurring attacks of severe pain in the right iliac fossa, radiating in various directions. The pain lasted one or two hours and was followed by tenderness. It was described as unendurable and paroxysmal. With each attack the patient had to give up work for two or three days.

Something in the case suggested the remote possibility of a stone, and I was unwilling to operate without an X-ray examination. The urine was normal in color, acid, and had a specific gravity of 1008. It contained no albumin and no sugar. The X-ray showed no stone, and with that assurance I removed the appendix, which was a long one. From the cæcum to its tip it was a sharp V in shape. Beyond the angle the lumen was distended with fæces; on the proximal side it was empty. This case seems to me to show well the reason why some appendices cause pain suggestive of an impacted stone.

[1] January 14, 1912: My most recent illustrative case is that of a woman of thirty-five, operated on fifteen years ago and also three years ago for abdominal pain. At these operations, the appendix, both tubes, and parts of both ovaries were removed. She presents herself for treatment on account of the persistence of this right-sided pain, and the X-ray—now used in her case for the first time—shows one large stone and four small ones in the right kidney.

The universal resort to the X-ray in abdominal diagnosis would be, I think, foolish. In the great majority of abdominal lesions the diagnosis is practically without reasonable chance of error, or at least of any error in which the X-ray would be of practical use. In the disease that I have been considering, however, habitual use of the method would obviate such mistakes as those that I have described. In my own practice I lean toward that side in which the X-ray is likely to prove superfluous, but in which the overlooking of a stone may mean disaster, rather than toward the side in which the chances of stone are, from the history and physical examination, so much in favor of stone that there is little possibility of error. In other words, I would insist on the X-ray more in those cases in which stone is suggested than in those in which the stone is sure to be present. That is, I would make the X-ray more and more widely used; more and more a method of precision in doubt—the greater the doubt, the greater the precision. Not that I would abandon for a moment the X-ray to confirm beyond a doubt a positive diagnosis; but I would extend its use to the much more frequent case in which the possibility of stone is suggested, if only remotely. Still further, I would use the X-ray in every abdominal case in which information of value is possible.

On the other hand, we must remember the sources of X-ray error, for even the most expert may make mistakes. I have been led into extensive and bloody search for ureteral stones that did not exist, as in the operation for phleboliths mistaken for ureteral stone; and yet this error may be avoided by the X-ray or a ureteral catheter in connection with this stone.

Such experiences suggest, of course, in the use of the X-ray the highest experts, who know not only the possible errors of conclusion, but how to overcome and neutralize these errors. It is by developing the X-ray methods in ureteral and genito-urinary surgery and in gastro-intestinal diseases that we shall find in this method the greatest assistance in avoiding errors in diagnosis.

NOTE ON THE MESOTHELIOMATA (SO-CALLED HYPERNEPHROMATA) OF THE KIDNEY.*

BY LOUIS BLANCHARD WILSON, M.D.,

OF ROCHESTER, MINNESOTA.

Director of Laboratories, St. Mary's Hospital.

ONE year ago, assisted by Dr. B. C. Willis, I presented before the Association of American Pathologists and Bacteriologists [1] the results of my studies on 48 cases of so-called "hypernephromata" of the kidney. The literature was reviewed from Grawitz's hypothesis of the adrenal origin of these tumors to January 1, 1910. My observations on the tumors and a re-survey of the relational development of the kidney and suprarenal supported Stoerck's [2] objections to the Grawitzian hypothesis. It seemed to me, however, that there were serious objections to Stoerck's suggestion that these neoplasms arise from convoluted tubules in the contracting kidney. On the contrary, the evidence presented seemed to support and extend Adami's [3] view that these tumors are mesotheliomata of renal origin. Indeed, it appears that all the phenomena observed to date in relation to the so-called "hypernephromata" are best interpreted by the hypothesis that they are the result of proliferation of islets of nephrogenic tissue (mesoblast) which have never become connected with the renal tubules (derived from the Wölffian duct).

Since my report Zehbe [4] has published his observations on a few specimens, which he holds confirm Stoerck's objections to the Grawitzian hypothesis and also Stoerck's suggestion that they do arise in compensatory hypertrophy of renal tubules.

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*Read before the Assn. of Am. Phys., May 10, 1911.

[1] Wilson and Willis: Jr. Med. Res., xxiv, 1910.

[2] Stoerk: Beit. z. Anat. u. Allg. Path., 1908, xlii, pp. 393-437.

[3] Adami: Prin. of Pathology, vol. i, pp. 745-747.

[4] Zehbe: Virchow's Arch. f. Path. Anat., Ed. 201.

Sisson [5] also has reported his studies on five adenomata of the suprarenal and five so-called "hypernephromata" of the kidney. He agrees with Stoerck and myself that the renal tumors have no relationship to the suprarenal, but he finds no evidence of their having arisen from contracted adult renal tissue. He re-states in part my view that they take their origin from isolated nephrogenic tissue, but says that they may possibly also arise from the ureteral bud.[6]

Since the previous report I have studied five more cases of nephrogenic mesotheliomata. All of these confirm the original observations, that each tumor contains areas which are histologically recognizable reproductions of the various stages of the development of the renal cortex from the nephrogenic tissue, while at the same time furnishing pictures which are not found in the suprarenal.

The relationship of the renal tumors of embryonic origin (teratomata, mesotheliomata) as we now understand them may be expressed as follows:

1. *Teratomata or the mixed tumors of Wilms.* These are the most common form of malignant renal tumors of early childhood. Histologically they contain, besides epithelial cells and round- and spindle-sarcoma cells, also hyaline cartilage, striped or unstriped muscle fibres and occasionally ganglion cells. Their origin is probably from very early inclusions within the nephrogenic tissue of portions of the myotome which normally should form skeletal structures.

2. *Nephromatous mesotheliomata* (the so-called malignant "hypernephromata" or "Grawitzian tumors"). These form the larger share of malignant renal tumors of the adult and are frequently wrongly diagnosed sarcomata. Their tissue elements and cell mutations are confined to those passed through normally by the nephrogenic tissue in the development of the renal cortex. They probably arise from masses of nephrogenic tissue which have remained isolated from the surrounding adult renal cortex.

[5] Sisson: Zeigler's Beit., Bd. 49, 1910.

[6] The obvious objection to this latter supposition is that we do not find in these tumors epithelium of the adult renal pelvic type.

3. *Wölffian "rests" or "tumors."* These are fairly numerous small masses of yellowish-red tissue included within the renal cortex and frequently mistaken for "adrenal rests." Histologically they are distinguishable as of Wölffian origin. They are seldom encapsulated and are always benign. They result from the inclusion within the early formed renal cortex of tubules of the atrophying Wölffian body.

4. *Adrenal "rests" or "tumors."* These are freely described by many observers, but are certainly much rarer than is commonly supposed. They are small, usually whitish masses embedded within the renal cortex and usually encapsulated. Careful microscopic examination of such masses will show that most of them belong in group 3, *i.e.*, are of Wölffian origin.

Such a classification may be of interest to the clinician as explaining certain diagnostic phenomena. Thus teratomata and nephrogenic mesotheliomata are rarely preceded by symptoms of other renal lesions, while primary carcinomata of the kidney very often take their rise from the site of renal calculi. Teratomata, derived from the earliest isolated embryonic tissue, develop in infancy or early childhood. Though of exceedingly rapid growth they are usually so well isolated that early they produce no symptoms except abdominal enlargement, and rarely form metastases.

Nephrogenic mesotheliomata may be considered as developed from embryonic tissue which, while isolated, is yet surrounded by structures developed from similar tissue. This may explain why these tumors usually fail to develop until late adult life. While their growth is often slow, the suddenness with which they sometimes appear after an injury may perhaps be due to the "rest" consisting of a relatively large amount of isolated nephrogenic tissue. That they originate from embryonic rather than adult epithelium may account for the fact that their metastases are by way of the blood stream and not by way of the lymphatics.

Though these suggestions must for the present remain somewhat speculative, they may not be unworthy of consideration.

THE SURGICAL TREATMENT OF DIVERTICULA OF THE URINARY BLADDER.*

WITH THE REPORT OF A CASE AND A NEW DEVICE FOR FACILITATING THE OPERATION.

BY WM. LERCHE, M.D.,

OF ST. PAUL, MINN.

THE presence of a diverticulum of the bladder, when so situated that stagnation of its content is favored, is a constant source of danger to the patient if it becomes inflamed.

Of the various methods of treatment of this condition, the radical removal of the diverticulum by excision has given the best result. The report of fourteen cases thus operated upon can be found in literature, namely, those of Alexander (1884), Czerny (1897), Riedel (1903), Pagenstecher, Young (3 cases), Wulff, Von Eiselsberg (1904), Porter (1907), V. Eberts (1909), Kroiss, Zaaijer, Brongersma (1911). To this number I wish to add the report of a case that has come under my own observation.

Male, aged thirty-eight. Measles, whooping-cough, and chicken-pox in childhood. At the age of twenty-eight the patient experienced two attacks of severe pain in the left abdomen and one attack in the corresponding part of the right side in the course of a year. These attacks were diagnosed as renal colic. He passed no blood in the urine, nor did he pass any calculi. At the age of thirty-one he had an attack of urethritis, which healed in three weeks. Nine months later he had an attack of gonorrhœa, which lasted for fifteen months, but finally healed completely. Urethral sounds were passed for a long time first by the attending physician, later by the patient. Four years previous to consultation the patient noticed thick whitish material in the urine at intervals of a few weeks. Occasionally he had spasm of the sphincter urinæ and could not quite finish the urination. He

* Read in abstract at the Minnesota State Medical Association, Oct. 6, 1911.

suffered no pain nor any other inconvenience. Now and then he noticed that on urinating in the morning he could pass urine again shortly afterward. During the last two years the whitish material in the urine has appeared at shorter intervals and has been more abundant, and the urethra has been somewhat sensitive. The condition grew worse since January, 1910, with frequent urination, and he was treated with irrigations of the bladder and instillations.

When the patient came under my care a general examination except that of the urinary tract was negative. The prostate was slightly enlarged, and an enlargement was felt in the region of the left seminal vesicle. Repeated examinations showed a residual urine of 200 c.c., which contained a great deal of pus and slime. There was no tenderness nor enlargement in the region of the kidneys or over the bladder. The urethra accepted a 29 F. sound. The bladder was irrigated daily and solution of nitrate of silver instilled. The urine cleared up considerably, but could never be kept entirely free from pus and shreds.

Cystoscopy.—After thorough irrigation of the bladder, 350 c.c. of a boric acid solution was left in the viscus and the cystoscope introduced. The bladder was found to be trabeculated, and there was evidence of cystitis. The left ureter could not be seen, but in that region was discovered a black hole. This opening (Fig. 1) was oval in outline with the lower border somewhat straighter than the upper. It was about 1 cm. in its longest diameter and its margin was thick, as shown in cut, with blood-vessels and radiating folds of mucous membrane curving over it. Whitish, thin shreds could be seen floating in and out of the opening. It was impossible to get the cystoscope into the opening. The left side of the posterior wall of the bladder was bulging forward (Fig. 2), and the right ureteral orifice was on a plane more posteriorly. A diagnosis of diverticulum was made and to verify this a radiograph was taken after introducing 400 c.c. of a 5 per cent. collargol solution into the bladder, a method first used by Volcker in radiographing the kidney pelvis. With the patient flat on his back the plate did not show anything abnormal, but with the patient turned about 35° the diverticulum showed up very well (Fig. 3). The radical removal of the sac was decided upon. In planning the operation the thought occurred to me that if the diverticulum could be distended inde-

FIG. 1.

Cystoscopic view of diverticular orifice.

FIG. 2.

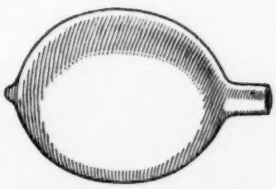
Diverticulum distended by inflated rubber bag.

FIG. 3.

Radiograph of diverticulum and bladder taken from left side.

pendently of the bladder, with the latter in a somewhat collapsed condition, it would materially lessen the difficulty of dissection by converting the diverticulum into a tense cyst and raising it higher up in the pelvis. To that end I had little rubber bags made (Fig. 4), which could be fastened securely with a silk thread to the ureteral catheter and wrapped around the latter, a tiny rubber band (*A*, Fig. 5) being slipped over to keep the bag, *B*, in place. When the bag is distended this rubber band is forced off and later

FIG. 4.



Rubber bag (actual size).

passed off by the urethra. The funnel-shaped part of the proximal end of the catheter is cut off (*C*, Fig. 5), in order to enable this end to be introduced backward through the distal end of the catheter carrying tube on the cystoscope. A Brown-Buerger cystoscope is used for the purpose. Fig. 6, *A*, shows the catheter with rubber bag being introduced into the mouth of the diverticulum, *B*. When the rubber bag is in the diverticulum, boric

FIG. 5.

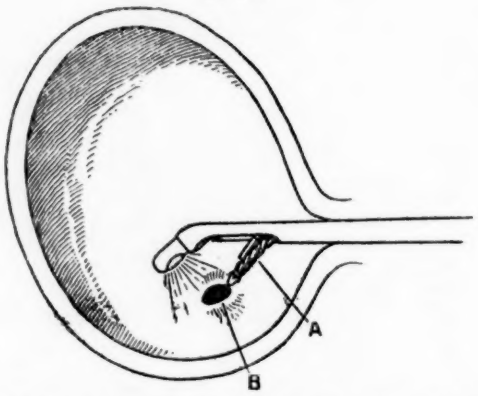
Rubber bag (*B*) tied to catheter and held by rubber band (*A*).

acid solution or normal saline is injected through the catheter into the sac until resistance is noticed. The corresponding amount of fluid is drawn off from the bladder. The bulging rubber bag can also be observed in the mouth of the diverticulum through the cystoscope. The number of cubic centimetres used will give the exact size of the diverticulum. When the latter is fully distended the proximal opening of the catheter is plugged by a thick, straight needle. The diverticulum in my case measured exactly 200 c.c.

Operation.—With 350 c.c. of a boric acid solution in the

bladder, the rubber bag on the ureteral catheter was introduced into the diverticulum through the cystoscope; 200 c.c. of boric acid solution was injected into the rubber bag in the diverticulum, while the corresponding amount was let out of the bladder, leaving about 150 c.c. or less of the solution in the latter. The distended diverticulum could be felt per rectum like a tense cyst. Ether anæsthesia. Through an incision 10 cm. long through the left rectus muscle, with the patient in the Trendelenburg position, the pelvis was entered extraperitoneally. The peritoneum was stripped off from the left side of the bladder and pelvic wall, and the tense wall of the diverticulum reached. The benefit of the

FIG. 6.

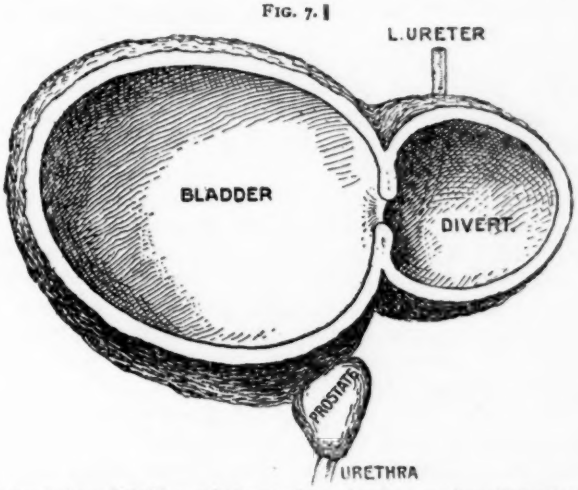


Catheter with rubber bag in cystoscope, ready to be introduced into diverticulum.

rubber bag scheme was immediately appreciated. An attempt was made to dissect the diverticulum off from the peritoneum, but this could only be done half way around on account of the firm adhesions. The outer layer of the wall of the diverticulum was therefore cut through, and it could then be shelled out. The left ureter was found on the mesial side of the diverticulum being pushed to the right, and the left seminal vesicle was behind and underneath it. The diverticulum had somewhat undermined the trigonum, and it extended backward into the hollow of the sacrum and was adherent to the rectum. The rubber bag was now emptied, and on cutting through the neck of the diverticulum from the left side the bag with the catheter could be pulled out through the abdominal wound. The orifice of the left ureter was seen on the mesial wall of the diverticulum about 1 cm. from the

opening into the bladder (Fig. 7). The diverticulum was removed and the opening in the bladder sewed up with two layers of continuous formalized catgut sutures, the left ureter being implanted into the bladder through the same opening. Split tube drainage with gauze wick was left in the large extraperitoneal cavity, and the abdomen closed except for drainage opening. The neck of the bladder was dilated to 43 F. with a Kollman dilator and a retention catheter was left in the bladder. The extraperitoneal drain was removed on the fourth day. Frequent spasms interfered with the bladder drainage, and a posterior

FIG. 7.



Lateral view of bladder and diverticulum, showing position of left ureter.

urethrotomy was therefore made and a large tube put into the bladder. The neck of the bladder was found hard and fibrous and did not admit the tip of the forefinger. The patient made an uneventful recovery and left the hospital on the thirty-fourth day. Three weeks later I removed part of the fibrous neck with Young's [1] ingenious median prostatic bar excisor *per urethram* under local anæsthesia.

The patient has been well since and has gained in weight. The urine was cloudy for some time after the operation.

The inner surface of the diverticulum was smooth and of a dull greyish-red color; there were no trabecula in the sac. The epithelium was absent in places; muscular fibres were present in the wall.

RÉSUMÉ OF OPERATIVE METHODS IN THE FOURTEEN CASES RADICALLY OPERATED UPON.

Vaginal Route:—Alexander's[2] case: A diverticulum of the bladder protruded from the vulva. A stone was removed from the sac and the latter was ligatured at its neck and cut off. The woman recovered with a small fistulous tract.

Sacral Route:—Pagenstecher's[3] case: Male, aged 33. Suprapubic cystotomy disclosed a diverticulum with its opening in the region of the left ureteral orifice. Drainage of diverticulum. Second operation: temporary resection of sacrum, removal of diverticulum, and transplantation of left ureter, which ended in the diverticulum, into the bladder. Recovery. Sacral scar painful. Sacral urinary fistula present when last seen.

Suprapubic Intraperitoneal Route:—Von Eiselsberg's case, reported by Wagner:[4] Male, aged 48. No prostatic enlargement. Cystoscopy: trabecular bladder, diverticulum near summit on right side. Intraperitoneal excision of diverticulum, closure of bladder wound with catgut. Retention catheter. Recovery.

Riedel's[5] case: Male, aged 61. Moderate prostatic hypertrophy. Partial prostatectomy. Continuation of symptoms. Later suprapubic cystotomy revealed a large diverticulum with large opening above right ureteral orifice. Bladder temporarily closed, then incision through right rectus muscle. Serosa over diverticulum incised and the latter dissected free, invaginated into the bladder, and removed. Diverticular orifice closed intra- and extravesically with catgut. Abdominal drainage of cavity, perineal drainage of bladder. Death.

Zaaijer's[6] case: Male, aged 58. Moderate prostatic enlargement. Suprapubic cystotomy. An opening found to a diverticulum behind the interureteric bar. Trabecular bladder. Septum divided and margins sutured. Functional result poor. Second operation: Laparotomy. Suprapubic cystotomy. Peritoneum over diverticulum incised, the sac dissected free, pulled into the bladder, and cut off. Diverticular orifice closed intravesically. Perineal drain behind bladder. Abdominal incision closed. Cystotomy wound left open—drainage. Recovery.

Porter's[10] case: Male, aged 34. Prostate moderately enlarged. Cystoscopy: Three diverticula. First operation, suprapubic drainage. Second operation, suprapubic cystotomy reopened and the orifices of the diverticula stretched. Drainage. Third operation, incision parallel with Poupart's ligament. Peritoneal cavity opened. Cystotomy wound reopened. The largest diverticulum was excised. Suprapubic drainage and retention catheter.

Later: suprapubic fistula keeps open if urethral catheter is not in place.

Suprapubic Extraperitoneal Route:—Czerny's[7] case: Male, aged 30, Traumatic stricture of membranous urethra. Suprapubic cystotomy revealed a diverticulum with opening in the region of left ureteral orifice. Suprapubic drainage of diverticulum. Second operation: Diverticulum

removed extraperitoneally through a transverse incision of the left rectus. The left ureter terminating in the diverticulum was transplanted into the bladder. Opening closed with two rows of catgut. Suprapubic drainage, also urethral retention catheter, drainage of the extraperitoneal cavity through abdomen. Four months later left nephrectomy. Recovery.

Young's[9] case: Male, aged 30. Urethral stricture. Cystoscopy. Two diverticula, one very large. Suprapubic extraperitoneal excision of both; right ureter in diverticulum was sewed into the bladder with a flap cut of mucosa. Drainage of bladder through a perineal urethrotomy. Drain of extraperitoneal cavity by tube behind prostate through perineum. Suprapubic fistula healed later after a Bottini operation on middle prostatic lobe. Cure.

Young's case: Male, aged 34. Cystoscopy. Small diverticulum in urachus caused by a fall. Suprapubic extraperitoneal excision of sac. Cure.

Young's case: Male, aged 63. Cystoscopy. Large diverticulum due to prostatic hypertrophy. Suprapubic extraperitoneal excision of diverticulum, perineal prostatectomy. Cure.

Wulff's[9] case: Male, aged 34. Cystoscopy, diverticulum on right side. Incision parallel with Poupart's ligament; diverticulum opened extraperitoneally, cavity tamponed. Later diverticulum excised and communication with bladder closed. Retention catheter in bladder. Bladder sutures failed. Later edges of opening into bladder had to be freshened and sutured again. Patient when discharged had 150-200 c.c. residual urine.

V. Eberts'[11] case: Male, aged 32. Right-sided nephrectomy for pyelonephrosis. Urine continued cloudy—hence suprapubic cystotomy, which revealed a diverticular opening 2.5 cm. to the outer side of the right ureteral orifice; drainage of diverticulum. In a third operation the diverticulum was removed extraperitoneally through a suprapubic incision, aided by a finger in the diverticulum through the reopened bladder wound; opening closed with a purse-string suture. Suprapubic drainage of bladder. Drainage of extraperitoneal cavity through perineum. Cure.

Kroiss'[12] case: Male, aged 28. Cystoscopy; X-ray. Orifice of diverticulum 2.5 cm. behind and to the left of the left ureteral orifice. Large suprapubic cross incision to left of median line. Diverticulum removed extraperitoneally with the aid of the finger in the sac through a suprapubic cystotomy opening. The opening of communication closed with interrupted sutures. Suprapubic drainage of bladder. Extraperitoneal cavity tamponed and wound left entirely open. Recovery.

Brongersma's[13] case: Male, aged 61. Bladder trouble since age of 15. Prostatic hypertrophy. Cystoscopy. Diverticular opening to the left of left ureteral orifice. X-ray. Suprapubic extraperitoneal excision of diverticulum. Closure of diverticular orifice with catgut. Recovery.

The case of Péan,[14] which by a number of writers has been grouped with the diverticula, seems to be a case of supernumerary bladder—an embryonal malformation—and is therefore perhaps better grouped with

the cases of Wolfler and Colzi (cit. by Schwartz [15]), and does not belong to the diverticula described in this paper. For the reason, however, that several writers have included the case, it is appended here.

Péan's case: Female, aged 15. Incontinence of urine since birth. A small sac was felt through the anterior vaginal wall, which communicated with the exterior through an 8 cm. long canal terminating 3 mm. below the normal urinary meatus. Péan dissected out the mucous membrane of the sac and canal and closed the defect. The sac communicated with the bladder. Cure.

Wolfler's case: Female, aged 12. Incontinence of urine since birth. Below the normal meatus was found a minute opening from whence came urine. No communication could be demonstrated between the bladder and sac. Both the urethral canals were forcibly dilated, and an anastomosis made between the bladder and sac with a specially constructed pressure forceps. The patient was "almost" relieved of her incontinence.

Colzi's case: In a young girl with incontinence of urine. An extra opening was found below and to the left of the normal meatus, from which dribbled urine. At operation it was found that this opening communicated with a sac into which ended the left ureter. The sac was extirpated and the ureter implanted into the bladder. Recovery.

Of other methods of treatment can be mentioned:

(*a*) Simple incision through the vaginal wall with drainage of the diverticulum.

Chaput's [16] case: Female, aged 50. Tumor to right of cervix uteri thought to be fibroma. Incision through vagina revealed a vesical diverticulum containing large quantity of urine and mucopus. Communication with bladder could not be found. Drainage of bladder and diverticulum. Recovery.

(*b*) Establishment of a fistula by sewing wall of diverticulum to the skin of the abdominal wall.

Ljunggren's [17] case: Male, aged 12 years. Ljunggren first made a fistula between diverticulum and abdominal wall. One year later he made an anastomosis between the bladder and the diverticulum. Cure.

(*c*) Perineal drainage of the bladder.

Burckhardt's case: (Cit. by Pagenstecher. The case was reported by Burckhardt, but not treated by him.) Male, aged 43. Cystoscopy. Diverticulum above right ureteral orifice. Perineal urethrotomy through which the bladder was drained. Death.

(*d*) Forcible stretching of the orifice of the diverticulum.

Guibal's [18] case: Male, aged 68. Gonorrhœal stricture and prostatic hypertrophy. Suprapubic cystotomy. The bladder of the size of a hen's egg; the diverticulum held a quart and a half. The orifice of the diverticulum was forcibly dilated with the finger. Suprapubic drainage. Death.

Mumford's case: Suprapubic cystotomy with drainage of the bladder was first done, without relief. Later suprapubic cystotomy with stretching of the diverticular orifices with negative result. Finally the case was radically operated upon. (Reported by Porter, *loc. cit.*)

Langer's[19] case: Male, aged 38. No stricture, stone, nor prostatic hypertrophy. Suprapubic cystotomy. Dilatation of the orifice of the diverticulum. Death.

(*e*) Curettement of diverticulum and closure of its margins with sutures.

Pousson's[20] case: Male, aged 78. Prostatic hypertrophy. Suprapubic cystotomy, three calculi. Middle prostatic lobe removed. A small diverticulum containing a calculus was curetted and edges of orifice freshened and united by sutures. Bladder drained. Cure.

(*f*) Invagination of diverticulum into bladder, freshening of margins of orifice, and closure intraperitoneally.

V. Eiselsberg's case. (Reported by Wagner, *loc. cit.*) Male, aged 58. Three diverticula demonstrated by cystoscopy. Laparotomy. One small diverticulum near the summit was invaginated into the bladder and the margins closed by sutures. The larger diverticulum could not be found. Death a few months later.

(*g*) New anastomosis between bladder and diverticulum.

Ljunggren's case, *loc. cit.* Cure.

(*h*) Enlargement of diverticular orifice by incision of the septum or crushing with forceps.

Young's case, *loc. cit.* Male, aged 66. Cystoscopy revealed two diverticula. Suprapubic cystotomy; incision of septa; suture of cut edges. Voluntary urination restored; patient well, but has 300 c.c. residual urine.

Zaaijer's case, *loc. cit.* Male, aged 58. Suprapubic cystotomy; division of septum; suture of cut edges; functional result poor. Later radical excision of diverticulum.

Serralach's[21] case: Suprapubic cystotomy; several incisions in the margin of the diverticular orifice. Recovery. Functional result negative.

Lennander's case reported by Zachrisson:[22] Male, aged 21 months. Retention of urine and cystitis came on after operation for phimosis. Suprapubic cystotomy disclosed a diverticulum. A fistula was established by sewing the bladder to the skin of the abdomen. In a second operation a strong silk thread was passed through the septum and the diverticular orifice and tied tight in order to cut through. In a third operation a strong curved forceps was applied to the septum and an opening was made by gradually tightening the forceps. Patient left hospital with 200 c.c. residual urine and cystitis. When seen 18 months after operation cystitis was still present. At postmortem, according to Lennander[23] the left kidney was found to have double pelvis with two ureters which ended in the diverticulum. The right ureter and the urethra were found in the bladder proper. Abscess in kidney.

(*i*) Suprapubic drainage.

Englisch's[24] case: Male, aged 60. Prostate somewhat enlarged, particularly the middle lobe. Diverticulitis. Suprapubic cystotomy; drainage of diverticulum for seven months; pain disappeared but diverticulum remained unchanged.

Strauss'[25] case: Male, aged 29. Frequent urination for years, worse

since age of 27. Suprapubic incision disclosed two thin-walled sacs communicating with the anterior wall of the bladder. Incision of sacs; drainage. Cure. Strauss describes this as a case of triple bladder—a congenital malformation. Englisch (*l.c.*) comments upon it as a case of diverticula of the bladder.

Fischer's[26] case: Male, aged 75. Suprapubic cystotomy; drainage of diverticulum. Improved. Death one year later from uræmia, pyelonephritis.

Wright's[27] case: Male, aged 38. Suprapubic cystotomy revealed a hypertrophied bladder, with which communicated a diverticulum. The latter was four times the size of the bladder and its orifice of communication was near the right ureter. Drainage. Death.

(*j*) Perineal drainage of diverticulum behind the prostate.

Cholzoff's[28] case. Male, aged 26. Cystoscopy; diverticulum on left side. Suprapubic cystotomy and perineal incision; left ureter which terminated in diverticulum was transplanted into an opening made in the bladder; diverticulum drained through perineum; bladder stitched to skin suprapubically. In a second operation an attempt was made to remove the diverticulum, but without success. Through suprapubic cystotomy the mucous membrane at the neck of the diverticulum was then cut through and the edges closed with catgut; suprapubic drainage of bladder and perineal drainage of diverticulum. Sutures gave way and diverticular orifice reopened. In a third operation the suprapubic fistula was closed and an extraperitoneal fistula curetted. All urine passes through perineal fistula.

Etiology and Pathology.—By diverticula are meant those limited protrusions or bulgings of the bladder wall which only affect a small portion of the periphery of the latter.

Of the older writers Heister used the designation diverticulum; Morgagni, Saccus; Walther, hernia vesica; Cruveilhier, hernia tunicaire de la vessie. Of other synonyms can be mentioned vesica bipartiti; vesicæ accessoriæ; cystocele interna (Chopart); vesica supernumeraria, etc.

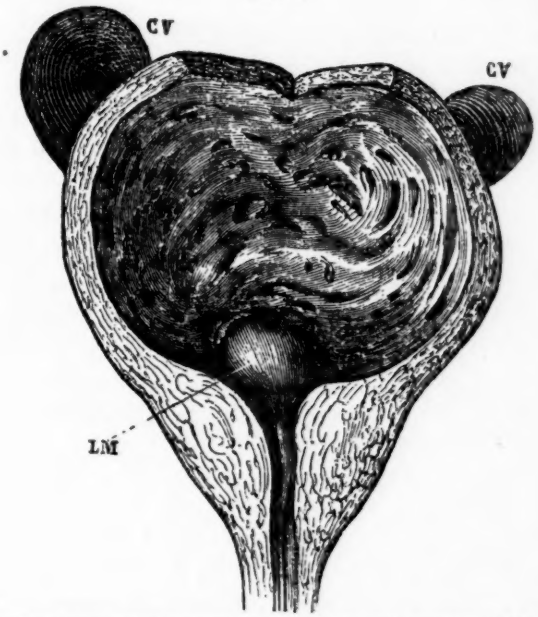
Englisch[29] divided diverticula of the bladder into those: (a) whose walls consist of muscular fibres and mucosa (Taschen); (b) whose walls consist of mucosa only (Zellen).

The former variety is also called congenital, the latter acquired diverticulum. Sugimura[30] following Aschoff unfortunately uses the terms true and false diverticula in the sense corresponding respectively to "taschen" and "zellen." Orth[42] understands by a false diverticulum a perivesical cavity that communicates with the bladder but that has none of the coats

of the latter; it is usually formed by a perivesical abscess that has ruptured into the bladder, and whose walls consist only of dense connective tissue. Such cases have been described by Targett and one reported by Billroth,[31] Voillemier and Le Dentu (cit. by Englisch) used the names cellules et poches.

Fano[32] calls both varieties cellules vésicales, and he mentions the following synonyms, kystes, chatons, appendices,

FIG. 8.



Diverticula symmetrically placed with regard to each ureter. (After Fano.)

poches, and cavites accidentelles. In his description Fano calls the small depressions little cellules, and the two large ones large cellules (Fig. 8). Civiale (cit. by Fano) distinguishes between cellules contractiles and cellules non-contractiles according to the presence or absence of muscular tissue in the wall of the diverticulum.

Targett[33] and Harrison[34] describe saccules and refer to pouches as mere depressions. Hodgson[35] speaks of pouches and refers to the saccules as merely the early start of the pouch.

Cases similar to the one reported by me in this paper have been described in recent German and French literature as congenital diverticula of the bladder.

The usage of the terms seems somewhat confusing and therefore in the following I apply the term diverticulum to both varieties, simply distinguishing the one with a coat of muscularis and mucosa as a "muscular diverticulum," and the other whose wall has mucosa only as a "mucous diverticulum."

Taschen (the muscular diverticula), according to Englisch, have certain seats of predilection, namely: (1) on the lateral walls of the bladder near the ureteral orifices; (2) toward the base of the bladder above the interureteric bar; (3) at the summit corresponding to the region where the urachus enters the viscus. They occur mostly singly, and most frequently near the left ureteric orifice, but two or more may be present in the same bladder. Englisch ascribes the reason for this predilection to anatomic causes. The longitudinal muscle bundles on both sides of the urethral orifice leave a space free, which is only covered by the circular and oblique muscle bundles—a locus minoris resistentia —and in case of intra-uterine obstruction to the outflow of urine, a diverticulum may develop at this weak spot. Englisch [36] [37] has repeatedly observed such obstructions in the new-born, often due to agglutination of the epithelial lining of the urethra. If the obstruction is merely of short duration the wall may just become pushed out a little at this spot, sufficient, however, to lessen its power of resistance. The further development may occur later in life, when again obstruction to free micturition arises, causing hypertrophy of the bladder wall and the formation of the diverticulum. Such development of the diverticulum may also take place without hypertrophy of the bladder wall. Where the diverticulum is congenital, the bladder is rarely found trabeculated. When a diverticulum is present in a hypertrophied bladder, trabecula may also be present in the diverticulum. Another seat of predilection is the top of the bladder. Two different types may develop here. The one consists of a dilatation of the vesical end of the urachus, which has remained patent. It has thin walls of circular and longitudinal muscle-fibres, and a mucous lining bearing more resemblance to a serous membrane. Its form is apt

to be cylindrical. The other type is a dilatation of the upper part of the bladder close behind the urachus; the formation of this Englisch explains as being due to the longitudinal muscle bundles immediately surrounding the region of the implantation of the urachus having thinner and wider meshes, while the circular fibres seem more strongly developed. The least frequent seat of the muscular diverticulum is above the interureteric bar, where they are found mostly in the presence of hypertrophy of the bladder in consequence of an enlarged prostate. The width of the diverticular orifice varies from 1 to 10 cm.; the thickness of the margin of the opening from 1 to 8 mm. The orifice may be circular or oval. This variety of diverticulum has been observed as large as six times that of the normal bladder.

Zellen (the mucous diverticula), according to Englisch, are of relatively common occurrence, as they come on in consequence of those disturbances to the outflow of urine, with which is connected hypertrophy of the muscular bladder wall—most frequently hypertrophy of the prostate. The depressions between the hypertrophied muscle bundles or trabecula correspond to the interstitial connective tissue. Early in its development the mucous diverticulum may have in its wall, beside the mucous membrane, the outer muscular layer of the bladder, but with the growth of the sac the muscle fibres are pushed aside and the wall consists of mucosa only, with muscle fibres around its neck and a little beyond. The width of the orifice of the diverticulum varies from 2 mm. to 2 cm. or more. In size these diverticula range from that of a pea to the size of the bladder or larger. It may occur singly or in large number; Englisch has seen a bladder with 40 diverticula, of which 28 contained calculi. This form does not show the regularity in distribution of the former variety. It is, however, mostly formed on the posterior wall from above the interureteric bar toward the summit, and on the side walls above the ureteral orifice toward the summit. It is rarely found on the anterior wall.

Targett [33] describes sacculi as protrusions of mucous membrane through the muscular coat of the organ in consequence of some mechanical obstruction to the outflow of urine. They occur mostly singly, but two or three may be present. If two are present they are often symmetrically placed with regard to each ureter (Fig. 8); such a case is also reported by Sugimura.[38]

They have narrow mouths and may occur at any part of the bladder except the trigone, but are most frequently met with toward the base. The explanation may be that the felting of the muscular fibres is here most interrupted by the entrance of the large vesical arteries. Targett demonstrated a specimen in which the right ureter terminates in the sacculus, owing to its formation at the spot where the ureter perforates the vesical wall, and the gradual shifting of its orifice.

Pouches, according to Targett, consist of an irregularly shaped protrusion of all the vesical coats more or less thinned by distention. They have wide mouths, and not infrequently result from the pressure of a vesical calculus.

Harrison [34] gives as causes for the formation of sacculi (1) intra-uterine, (2) obstacles to micturition, (3) traumatic. He describes pouches as mere depressions in the most dependent portion of the bladder in which the whole thickness of the wall is involved.

Buckston Browne [39] suggests the following division: (1) the ordinary sacculi, (2) the post-trigonal pouch, and (3) the post-prostatic or trigonal pouch. Both the latter varieties usually hold calculi. Browne reports cases of post-prostatic pouches of considerable size containing calculi.

Hodgson [35] explained the formation of pouches as follows: In cases of long-continued obstruction to free evacuation of the urine, the bladder becomes gradually dilated as the amount of residual urine increases in quantity, and the muscular coat is hypertrophied in proportion as the impediment to free micturition progresses. As the musculature becomes hypertrophied, the fibres gather into bundles between which are seen depressions of the mucous lining when the viscus is contracted. If the obstruction continues to advance, the residual urine to accumulate in larger quantities than is consistent with further general dilatation of the viscus, and the muscular coat begins to act with increased power, the efforts to micturate unavailing to expel the whole of the fluid forward cause the expulsive force to act on the bladder. The residual urine now dilates the little depressions by degrees into pouches, which become larger and larger as the disease progresses, until they may attain even the size of a man's fist. This process extends over a long course of time. Internally, each pouch is lined with the displaced mucous membrane; exter-

nally, its wall is formed by submucous fibrous tissue, thin and dilatable when the sac is small, hard, gristly, and resistant for the most part when large. In addition there is a peritoneal covering where this membrane is reflected. Generally speaking the size of the pouches is in inverse ratio to their number, being either small and numerous or large and few.

Young [8] found that in all of the cases that had come under his observation, either operated upon by him or seen post mortem, the walls of the diverticula contained muscle in varying degree, even in those due to obstruction late in life.

The largest diverticulum on record is that reported by Warren Greene.[40] Male, aged 84. Prostatic hypertrophy. Postmortem revealed a hypertrophied bladder communicating through an opening on its left side with a diverticulum which held about one gallon of limpid urine. There was no muscular tissue in the wall of the diverticulum.

The following interesting case of Holmes [41] is included here because it shows that a mucous diverticulum may also form in utero. In a newborn, otherwise well-built boy was found a protruding belly. Death in eight days. Postmortem showed great defect in the musculature of the belly. The kidney substance, particularly on the left, had greatly disappeared, and the ureters were distended and tortuous. The bladder consisted of two sacs, of which one had the ureteral orifices and the urethra, which were patent. The wall of the bladder proper was greatly hypertrophied—three times thicker than normal. The second sac, occupying the right side of the pelvis directly under the skin, was round and of the size of the bladder, with which it communicated through an opening half an inch wide. Its wall was thin and had not a trace of muscle fibres. Cause of death said to be obstruction to urination.

The conclusions, in regard to the etiology, to be drawn from the foregoing are that both the muscular and the mucous diverticula may form before birth and also that they may both develop later in life; but in either instance they are formed in consequence of some obstacle to the outflow of urine.

The presence of muscle in a large diverticulum does not seem to be a proof of the congenital origin of the latter, as maintained by Englisch and others, because muscle tissue has been found present in large acquired diverticula. The termination of one of the ureters in the diverticulum is by some

considered a proof of the anomaly being congenital. The specimen demonstrated by Targett, however, shows the ureter terminating in a diverticulum due to obstruction to micturition caused by an enlarged prostate.

In my own case it is possible that the fibrous changes in the neck of the bladder have been the slow cause of the trabeculation of the viscus and of the formation of the diverticulum. The trabeculation of the bladder proper, the absence of trabecula in the diverticulum, and the shape of the orifice of communication would rather be in favor of the view that the diverticulum has originated late in life. The almost straight lower margin of the diverticular orifice suggests that that shape has been determined by a hypertrophied bundle of muscle, and that the formation of the diverticulum therefore has taken place secondarily to the trabeculation caused by the obstacle to urination. If that is the case the vesical end of the ureter has simply become gradually shifted into the diverticulum in the course of its development by pressure. The anlage, however, may have been congenital in the sense regarded by Englisch.

An entirely different view is taken by Pagenstecher, who considers the muscular diverticulum an anomalous embryonal development—due to a superabundance of tissue. There are apparently no better proofs for the theory advanced by Pagenstecher than for the former.

Inflammation is a grave complication in case of diverticulum. Cystitis may be primary and extend into the sac, causing diverticulitis or *vice versa*. Most diverticuli have thin walls and little if any power of contraction. If the sac is dependent and the orifice of communication with the bladder small, stagnation is favored, and with inadequate drainage the pathologic process is progressive. Peritonitis or pelvic abscess may follow diverticulitis, and thrombosis of vessels may occur as reported in a case by Murchison.[43] A large diverticulum may compress surrounding organs and cause damage, particularly to the ureters, and in consequence to the kidneys, causing hydronephrosis, later by ascending infection pyelo-

nephritis and pyonephrosis. Calculi are at times found in the diverticula and cases of new growth in the sac have been reported by Targett,[44] Young,[45] and Perthes.[46]

Symptoms.—A diverticulum may be present in the bladder without giving rise to symptoms, and it may be accidentally discovered postmortem. There is no pathognomonic symptom of this disorder, but the most characteristic one is perhaps that the patient after urination feels as if the bladder had not been completely emptied, and he is able almost immediately to repeat the act, voiding a considerable quantity. This is explained by Hodgson in the following way: The orifices of the vesical pouches are bounded on all sides by bundles of muscular fibres, very much hypertrophied. When the bladder is filled with fluid the hypertrophied muscle bundles are flattened out over the surface, and the orifice of the pouch is rendered patulous. As the urine is being expelled, the general muscular coat performs active contraction, its fibres aggregate themselves into separate bundles, which are gradually approximated to each other, those of them which bound the orifices of the pouches acting as sphincters and shutting up a certain quantity of urine, which is poured into the pouches in the reaction backward of the expulsive force due to the obstruction in front. Thus the diverticulum is filled with urine and its neck is simultaneously closed by contracting muscle bundles. After the urine has been evacuated from the bladder the contracting muscular coats relax and the urine confined in the diverticulum flows out.

Sometimes there is painful urination, particularly in large diverticula. In several instances tumor has been felt above the symphysis or per vagina or rectum. However, it is with the advent of complications, especially inflammation, that a diverticulum gives rise to symptoms. Cystitis and diverticulitis is the most frequent complication and is accompanied by the usual train of symptoms, *i.e.*, painful and frequent micturition of turbid, sometimes stinking, urine. Hæmaturia may appear early before diverticulitis is present, due, perhaps, to circulatory disturbances from distention. In my own case

there was early in the history a diverticulitis of a more chronic type, with periodical discharge of large quantities of slimy pus, followed later by an acute exacerbation. Sometimes, in a case of long standing, the secondary kidney disorder may overshadow the bladder trouble.

Diagnosis.—The introduction of a catheter immediately after the patient has urinated will usually disclose a considerable quantity of residual urine. By the aid of the cystoscope the opening into the diverticulum may be found, and a ureteral catheter may be introduced into the latter to roughly estimate the depth. If the opening into the sac is sufficiently large, the cystoscope can be introduced through it and the interior of the sac inspected. The diverticulum may be measured with my rubber bag as described above, and then palpated bimanually while distended. Radiographs taken in lateral and frontal view, after filling the bladder with a 5 or 10 per cent. collargol solution, are of the greatest value, especially where cystoscopic examination cannot be carried out.

Prognosis.—According to Englisch the mortality rate in cases of diverticulitis is 83.1 per cent. The results of palliative treatment and operative treatment other than radical operation have not been encouraging. In the fifteen cases radically operated upon there has been one death.

Sex.—Most cases of vesical diverticula reported have occurred in males, but there are several cases of diverticula in females on record. A very large diverticulum was found postmortem in a woman 59 years old, reported by Hofmokl.[47]

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PRIMARY TUBERCULOSIS OF THE PENIS.*

I. A REPORT OF TWO CASES OF PRIMARY TUBERCULOSIS OF THE PENIS FOLLOWING NON-RITUAL CIRCUMCISION.

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II. NOTE ON PRIMARY TUBERCULOSIS OF THE FORESKIN.

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PRIMARY tuberculosis of the penis is a very rare condition. Many authors upon diseases of the genito-urinary system do not mention it at all. It is stated in Watson and Cunningham [1] that primary tuberculosis of the meatus, urethra, or glans probably does not occur, and that when the disease appears at these points it is secondary to other foci higher up in the urinary tract. Keyes [2] states that tuberculous ulcers may appear upon the glans, or result from infection during ritual circumcision. White and Martin [3] state that tuberculous ulcers on the penis are extremely rare, and that they cannot be distinguished from chancroidal lesions by inspection. They have, however, a history of very slow extension; they are usually associated with tuberculous lesions in other parts of the body, sometimes exhibiting about the periphery of the ulceration grayish semitransparent miliary tubercles, and on microscopical examination of the scrapings of the lesion often show tubercle bacilli. Moreover, inoculation of guinea pigs will disclose the true nature of the lesion. They also state that a differential diagnosis can be made only by autoinoculation; a valuable means of determining the presence

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or absence of the chancroidal virus, but one which is not infallible. Its value is perhaps best formulated by stating that the majority of chancroids will produce ulcers of a similar type in inoculation, while the majority of other ulcers, syphilitic, tuberculous, or inflammatory, will not produce such lesions.

Verneuil,[4] in 1883, expressed the opinion that primary genital tuberculosis which did not depend on scrofula was probably caused by direct infection during coitus. Poncet[5] reported, in 1890, to the French Congress for the Study of Tuberculosis an article on "Tuberculosis having its Origin in the Penis." He mentions three varieties: (1) balanopreputial tuberculosis; (2) tuberculosis of the mucous membranes, this variety usually showing itself first in the deep urethra; (3) tuberculosis of the urethra in the form of fungous masses involving the periurethral tissues.

Kraski[6] observed on the dorsum of the glans penis of a patient aged forty-nine years an ulcer the tuberculous nature of which was demonstrated microscopically after removal.

Senn[6] believes that in many cases of destructive lesion treated by amputation of the organ and in which no recurrence followed the operation, the disease was not carcinoma but tuberculosis. He reports the following cases:

CASE I.—John M., age thirty-one, with no history of a syphilitic infection. Ulcer first began on the external surface of the prepuce. There was no enlargement of the glands at the time. The ulceration and sloughing extended successively to the glans and body of the penis and finally resulted in almost complete destruction of the entire organ. Later the inguinal glands and skin covering the scrotum became involved. These glands became caseous and several well-marked tuberculous abscesses developed. The discharge from the extensive ulcerating surfaces resulted in inoculated tuberculosis which covered considerable of the gluteal regions on both sides. Some of the ulcers would heal from time to time, after which the new scar would again break down to give place to an ulcerated process. No signs of syphilis could be detected on any part of the surface of the body or in any of the internal organs. The patient was subjected repeatedly to anti-syphilitic treatment, preparations of mercury and iodine were given without improvement; in fact, such treatment aggravated the local conditions and still further impaired the general health of the patient. The patient was then placed

on anti-tuberculous treatment, local and general, consisting in the use of balsam of Peru followed by iodoform with repeated curettage and the internal administration of guaiacol and cod-liver oil. The disease was arrested, the ulcers healed rapidly, and the general health so much improved that the patient resumed light work.

CASE II.—Emil S., single, white, florist, German, age twenty-one years. In this case the lymphatic glands in the groin became involved, after a considerable portion of the penis had been destroyed by ulceration and sloughing. Syphilis was suspected, but most energetic treatment made no impression on the progress of the disease. Local and general anti-tuberculous treatment with complete excision of all the infected tissues effected a speedy and permanent cure. The tissues were examined for tubercle bacilli with negative results, but isolated multinuclear giant-cells were found.

The diagnosis of tuberculosis upon the evidence set forth in the two preceding cases cannot be accepted as positive. Multinuclear giant-cells are also found in syphilis and would not aid in the diagnosis. Senn bases the strongest argument for the diagnosis of tuberculosis in the fact that rigorous anti-syphilitic treatment not only failed to arrest the disease, but resulted in aggravation of the local conditions and impairment of the general health of both patients, while the anti-tuberculous treatment yielded the most prompt and satisfactory results.

The great majority of cases of primary tuberculosis found in the literature have arisen from ritual circumcision. The ceremony [7] may be briefly described as follows:

The rite is performed among the Jews by a Mohel or surgeon, and may be divided surgically into three parts.

1. The Milah: The child is placed upon the grandfather's lap, the Mohel grasps the prepuce, draws it forward and places it in a slit shield, and cuts it off with a single stroke of the knife.

2. The Periah: The inner lining covering the glans is then stripped back with the thumb and index-finger of each hand until the glans is exposed.

3. The Mezizah: The Mohel takes some wine in his mouth and applies his lips to the penis, exerts suction, spitting the blood and wine into a receptacle; the hemorrhage is afterward

controlled. This was commonly practised by Jews until some years ago, when at Krakow a great number of children were infected with syphilis. It was traced to a Mohel who had contracted the disease; and after this the use of a glass cylinder was introduced, so that the Mohel should no longer touch his lips directly to the wound.

The following cases of tuberculosis following ritual circumcision have been collected from the literature:

MELECOT[8] reports the following case:

A Jew, age fourteen years, was circumcised when eight days old according to ritual. The ulcer was first noticed when patient was thirteen years of age on the glans penis circumscribing the meatus. The edges were dentated and slightly discolored. The base was pale and smooth, there was no formation of pus, and there was no pain on pressure. The patient's face was pale, there was emaciation, but no pulmonary lesion was found. The patient was taken to the Pasteur Institute, and fragments of the ulcer were removed and examined for tubercle bacilli; none could be found. The fragments were then mixed with 4 c.c. of sterile water and guinea pigs were inoculated; these developed tubercles. When the case was seen one year later, the ulcer was in the same condition but the general condition was better.

LINDEMANN[9] reports two cases as follows:

The operator, the same in both cases, came from a tuberculous family and died of the same disease two months after infection of his cases. The cases are as follows:

R. S., parents healthy. Circumcised on the eighth day after birth. Wound healed within two weeks except a small area near frenum, which developed irregular edges and a cheesy base in which miliary tubercles could be seen. The ulcer was healed, but the buboes were removed and pus and cheesy matter evacuated. Recovery followed, but at the age of three years spondylitis developed with compression myelitis, and death followed from phthisis.

L., this case was identical with the first case. However, at the age of one year a cold abscess developed over the wrist.

LEHMANN[10] reported ten cases, all inoculated by the same operator, who died afterward of phthisis. Of these cases six infants died, three of tuberculous meningitis, one of marasmus, after suffering an entire loss of the skin investment of the penis from gangrene, one from sepsis, and one from an intercurrent disease, diphtheria.

HOFMOKL[11] reports a case as follows: Infant circumcised when eight days old; seven weeks later an ulcer developed by the side of the frenum, with a bilateral suppurative adenitis. No tubercle bacilli were found, and anti-syphilitic treatment was begun. This treatment was without effect. The ulcer was then curetted and the glands removed.

On section they showed tubercle structure, and the bacilli could be stained. This patient recovered.

ELSENBERG[12] reports the following case: S. P., aged five months. Ulcer developed near frenum, with infiltration extending into the prepuce. The inguinal glands were very much enlarged, and the overlying skin was livid, boggy, and perforated. The discharge from the sinuses was watery and contained flocculi. Later an abscess developed behind the mastoid. Mercury was prescribed without effect. The wounds remained open, and a temperature of 104° F. developed. Death took place from sepsis. No postmortem could be obtained, but section of the prepuce and glands showed tubercles and tubercle bacilli. The same author reports three other cases which recovered.

WILLY MEYER[13] reports a case as follows: Infant born in Roumania, ritually circumcised, came to this country at seven months of age. The parents said the child had been treated for syphilis since the disease started. This treatment was continued for a month longer without results, and then all diseased areas were removed. On section the specimen showed tuberculous tissue and tubercle bacilli. Recovery followed in this case.

KAREWSKI[14] has reported three cases; one died of sepsis.

MARTIN W. WARE[15] reports the following case: C. M., an infant three months of age, born of healthy parents, circumcised according to ritual when one week old. The wound did not heal, but became inflamed, and the inguinal glands enlarged. The child was placed on anti-syphilitic treatment for two weeks without effect. The right inguinal glands became very much enlarged, and, in the site of circumcision, an ulcer with irregular edges developed. The base contained flabby granulations, with a scant secretion. The rectal temperature rose to 103° F. The ulcer was then curetted, the buboes incised, and an ounce of pus removed. The anti-syphilitic treatment was continued. The wound became worse, the penis enlarged, and a lymphangitis, starting from a small yellow nodule, developed from its dorsum. The diagnosis of tuberculosis was then substituted for that of syphilis, and later confirmed by section of the inguinal glands, which showed distinct miliary tubercles.

DOBROVITS[16] also reports a case of tuberculous ulcer following circumcision according to ritual; and in a similar case reported by Perlis,[17] complete destruction of the penis took place.

The following case has been reported by Dr. SARA KELT-KAKELS:[18] Baby, age six months, breast fed, born of healthy parents who had one other child, three years of age and healthy. Was circumcised according to ritual at nine days. The wound was sucked by the operator, who was an elderly man and who had followed his occupation for thirty years. He had a cough, and presumably had tuberculosis. After the operation the wound inflamed and the surrounding part became red and swollen. The child became feverish, and suffered from a slight dyspeptic disturbance. About four weeks later the mother noticed a swelling in the left groin. A physician was then consulted. He prescribed an oint-

ment, but no improvement followed. The child was later taken to Mt. Sinai Dispensary. At this time the child showed a small hydrocele on the right side and a glandular swelling in the left inguinal region. Some weeks later the woman returned, and the prepuce of the child looked at this time œdematous, and there was a slight nodule to be felt in the periphery. Fluctuation was detected in the glandular swelling. This was aspirated and a thin serous discharge mixed with flocculi escaped. A suspicion of tuberculosis was then entertained, and Pirquet's was positive. Dr. Eugene Paul Bernstein examined the discharge from the sinus and reported the presence of tubercle bacilli. Later the enlarged suppurating glands were removed by Dr. Charles Goodman, and the pathological examination showed tuberculosis. The baby was well fed, weighed 19½ pounds, and looked rosy and healthy. The temperature was normal, thoracic organs were normal except a few râles over the lungs, the spleen was slightly enlarged, and there was a deep sinus in the left inguinal region, which was gradually filling up with healthy granulations.

The two cases of primary tuberculosis of the penis which I desire to report followed non-ritual circumcision, and are examples of wound infection by the tubercle bacilli. Both cases were carefully studied by Dr. A. S. Warthin, Professor of Pathology of the University of Michigan, and the diagnosis of tuberculosis made after section of the removed tissue.

The cases are as follows:

On April 16, 1902, J. S., thirteen years of age, and younger brother, American by birth, family and personal history negative, were circumcised non-ritually by the same surgeon, at the same time and at the same place, where just previously an operation on a tuberculous patient had been performed by the same surgeon. At the end of a week the wounds had almost healed, and both cases were dismissed as cured. Fifteen days later both boys noticed a marked swelling of the tissues of the penis, posterior to the glans, in the line of the incision of the operation. In the case of J. S., the swelling continued until it became the size of a hen's egg. The swelling was opened at various points by the attending physician, and pus was evacuated, and flax-seed poultices were applied. On May 26, 1902, the patient was admitted to the hospital of the University of Michigan. At the time of admission most of the swelling of the penis was on the ventral aspect of the organ. No fluctuation could be detected. The small

incisions about the line of circumcision gave off a small amount of yellow pus. There was swelling in the region of the epididymis of the left side about the size of the little finger, soft, but not painful, and the glands of the inguinal region became swollen, but not tender.

Dr. C. G. Darling, Clinical Professor of Surgery of the University of Michigan, dissected away as far as possible the diseased tissues, curetted the granulating surfaces, and brought the edges together with black silk. The tissue was sectioned, the diagnosis of tuberculosis was made by Professor A. S. Warthin. The patient was discharged, cured, July 4 of the same year.

The younger brother was operated privately by Dr. C. G. Darling. The ulcer was curetted after removal of the diseased tissue and treated in the same manner as the first case. The ulcer healed after the first operation, and the patient was discharged as cured. The diseased tissue was sectioned and showed tuberculosis. Bacilli were found in small numbers. The diagnosis in this case was also made by Professor Warthin.

At the present time, nine years later, both boys are living and well, and have shown no signs or symptoms of tuberculosis since the operations occurred.

CONCLUSIONS.

First. That though primary tuberculosis of the penis is comparatively rare, it is probably more common than might be judged from the literature.

Second. It is possible that many cases of primary tuberculosis of the penis have been mistaken for syphilis, chancroid, and cancer.

Third. That tuberculosis following ritual circumcision is less common at the present time than formerly, and no doubt due to changes in the ritual; and that the practice of suction should be abolished.

Fourth. The two cases which I have just reported are due to unclean surgery. The tubercle bacilli were evidently carried from the patient who had been operated upon just previously to the wounds of both circumcised patients by unclean hands or improperly sterilized instruments or other

articles used in the operation. Both cases are examples of wound-infection by the tubercle bacilli. That both boys were well and had at no time shown any symptoms or signs of tuberculosis up to the time of operation; that the parents were both well; that the operations were performed by the same surgeon, at the same place and time; and that preceding the operations a tuberculous patient had been operated, leave no room for doubt concerning this mode of infection.

II. NOTE ON PRIMARY TUBERCULOSIS OF FORESKIN.

Since Dr. Wilson's report was written one case of primary tuberculosis of the foreskin has been sent to this laboratory for examination.

CASE 749–N.—Private patient of Dr. D. M. Cowie, young adult, teacher, good family and personal history. No other evidence of tuberculosis. No sexual exposure. Personal habits and character beyond suspicion. No known possibility of infection. Small, painless nodule developed upon the foreskin. Circumcision by Dr. Cowie.

The mucous surface of the foreskin presented a flattened induration about 1 cm. in circumference and 5 mm. in thickness. There was no ulceration. On microscopical examination, the indurated area was found to be composed of a mass of typical miliary epithelioid tubercles with caseating centres and giant-cells. The histologic appearances were in no way like those of a chancre; the individual tubercles stood out sharply with relatively little inflammatory reaction about them; the main portion of the mass being made up of confluent miliary tubercles. The epithelium was intact; and the process was more subepithelial, that is, deeper than a chancre. A nerve ending and a relatively large nerve-trunk lay in the middle of the mass of tubercles. Some of the neighboring veins contained organizing thrombi. The epithelioid areas were completely avascular; and, as a final proof, tubercle bacilli were demonstrated in numbers in the caseating centres. Small beginning tubercles were also found in the walls of the neighboring veins. The largest area of caseation contained numerous polynuclear leucocytes and showed central softening (abscess formation). No other organisms were found, however.

The case must be regarded, therefore, as a very rare instance of the localization of tuberculosis in the foreskin, as a primary process, independent of any local injury. The depth

of the process and the vascular involvement make me regard it as most probably a hæmatogenous infection, and not one derived through the mucosa. In the absence of tuberculous lesions elsewhere in the body, or at least of lesions that could be recognized, the process would have to be regarded as a cryptogenic hæmatogenous infection. When last heard from the patient showed no other signs of infection, and the local wound healed promptly.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, Held at the German Hospital, New York, October 25, 1911.

The President, Dr. Charles L. Gibson, in the Chair.

MEMBRANOUS PERICOLITIS.

Dr. Otto G. T. Kiliani presented a man, 28 years old, whose chief complaint was pain, of a "burning, pulling, or dragging" character, in the right lower abdomen. He was constipated, vomited frequently, and had lost weight. He gave a history of having had an appendectomy done four months ago.

Examination showed a scaphoid abdomen, soft, without rigidity. There was a scar in the right lower quadrant, with slight tenderness to the outer side of it. The colon was distended, movable, and easily palpable. A series of X-ray pictures, taken after the ingestion of a Rieder's bismuth meal, showed a dilatation of the colon, and at the end of twenty-eight hours a considerable part of the bismuth paste remained in the gut.

Operation: The colon was exposed through a right rectus incision. It was found freely movable and sharply pinched at its hepatic flexure, descending for a distance of a few inches and then turning upward and across the abdomen. It was bound down here and there by many adhesions and covered with newly-formed connective tissue. The adhesions were separated and the colon anchored with chromic gut sutures to the lateral abdominal wall. The abdomen was then closed in separate layers.

LOCAL BLOOD INJECTION FOR UNUNITED FRACTURE.

Dr. Kiliani presented a man, 29 years old, a chauffeur. In April, 1911, he was struck by a car, sustaining a fracture of both bones of the right leg at their lower third. He was treated at the Roosevelt Hospital for several weeks, and then came to

the German Hospital, where a plaster case was applied. He returned to the hospital six weeks later, at which time Dr. F. Kammerer sutured the fragments of the tibia with two silver wire sutures.

An examination made on Sept. 1, 1911, showed that the fractured tibia was still ununited. The patient's leg had been in an extension apparatus, in plaster; he had received Bier's hyperæmic treatment, massage, and mild active motion. The patient was then given 10 c.c. of venous blood, injected into the line of fracture. A similar injection was given on Oct. 7, 1911, and the slight false movement of the fragments diminished decidedly. He left the hospital on Oct. 26 on the road to complete recovery.

Dr. Henry H. M. Lyle said that in the past four months he had seen three cases of non-union after the use of Lane's plates. In two of these cases the plating had been done for non-union.

He had used "Bier's blood injection" with excellent results. Last year he had shown before this Society a case of non-union of both bones of both legs. This case had exhausted all the ordinary orthopædic and surgical methods, yet union was obtained by the injection method in four weeks.

The results in this case and in others had convinced him that this method should always be tried before resorting to the use of Lane's plates. Dr. Kiliani's striking result had deepened this conviction.

DIVERTICULUM OF THE ŒSOPHAGUS DUE TO CARCINOMA.

Dr. Kiliani presented a man, 68 years old, who about ten months ago first noticed difficulty in swallowing, and for the past five months he had been unable to eat any solid food and swallowing gave rise to pain in the neck. There was no history of vomiting, but he regurgitated his food frequently. There was no blood in the stools. The patient had lost eight pounds in weight.

An examination of the neck showed atrophy of the thyroid gland. The thyroid cartilage stood out prominently, and there was a gurgling sound when the patient swallowed. One of the submaxillary glands on the right side was enlarged and hard. A No. 16 French bougie could be passed into the stomach; a No. 22 failed to pass, meeting with an obstruction eight and a half inches from the teeth.

On August 24, 1911, a gastrostomy was done by Dr. Fisher by the Carter-Senn method, and about a month later he made an

incision, six inches long, beginning at the top of the sternum and extending obliquely outward on the left side to about the level of the larynx. The œsophagus, in this location, was found to be normal, but below it became lost in a hard tumor mass which extended downward and backward to the vertebral column. It was apparently malignant, and no attempt was made to remove it. The omohyoid muscle, which had been previously cut, was reunited, and the wound was closed with silkworm gut.

ISOLATED FRACTURE OF THE TRANSVERSE PROCESS OF THE FIRST AND SECOND LUMBAR VERTEBRÆ.

DR. KILIANI presented a man, 33 years old, who complained of a sharp, stabbing pain in the right kidney region, radiating across the back to the opposite side. There was also a constant aching pain on the right side which radiated to the shoulder. The patient denied luetic infection. He gave a history suspicious of pulmonary tuberculosis; otherwise, his personal as well as his family history was negative.

The patient stated that his present history dated back three weeks. He said that four days ago the pains in the back became more severe, and that two days before admission they were "maddening," so that they would double him up. He had vomited several times. There was no blood in the urine; no frequency; no "sand."

In addition to the above history, it was subsequently elicited that seven months ago the patient had fallen a few feet, landing on his back. Following this fall, he had not complained of any pain or inconvenience. An examination of the abdomen was practically negative, and cystoscopy revealed nothing abnormal. Posteriorly, there was a point of tenderness on the right side, two inches from the median line, at about the level of the crest of the ilium. In forcibly landing on his heels, he experienced a severe pain. Bending forward was not limited, but on assuming the erect posture he experienced a severe "catching" pain. Backward motion of the spine was slightly limited; otherwise, motion was not interfered with.

A diagnosis of fracture of the transverse process of the first and second lumbar vertebræ was made, and the exact location of the fracture was verified by the X-ray. Firm strapping of the parts gave the patient only partial relief, and after this method of treatment had been tried for about three weeks, the loose fragments of bone were removed by Dr. Kiliani, with entire relief.

TUMOR OF THE BRAIN.

DR. KILIANI presented a man, 51 years old, the history of whose illness dated back ten years, when he began to complain of headache and weakness in different joints, especially on the right side. He also had a sense of numbness in the fingers, sudden lapses of memory, and periods of semiconsciousness. He had perfect control of the bladder and rectum. There was no history of vomiting. His vision had gradually become impaired until he was scarcely able to recognize objects. Hearing was normal.

Upon admission to the German Hospital, on June 23, 1911, an examination gave the following chief points of interest: His pupils were equal and reacted sluggishly both to light and accommodation. The fields of vision were contracted, especially the lower, and acuteness of vision was diminished. There was no nystagmus; no paralysis of the extrinsic muscles. There was distinct muscular weakness on the right side of the body; no areas of anæsthesia, but sensation was somewhat impaired. There was no muscular inco-ordination. The knee-jerks were exaggerated, the right more so than the left. There was no Romberg; no Babinski. With the exception of sight, the special senses were not impaired. There was no facial paralysis nor anæsthesia. There was double choked disk.

At a subsequent examination, made on October 12, 1911, the abdominal reflexes on the right side were found to be absent. The Babinski reflex was present on the right side and the knee-jerks were exaggerated. Muscular weakness was marked on the right side, while the sensory reactions on that side were diminished. There was no tremor. The patient was emotional, and subject to fainting spells and attacks of petit mal. There was motor aphasia. No nystagmus.

Dr. George Jacoby made a diagnosis of left-sided brain tumor, starting in the white substance, possibly involving the thalamus and extending outward to the cortex. A decompression operation was done by Dr. Kiliani on October 30, 1911, followed by considerable improvement in the patient's symptoms. Radical removal of the tumor was considered impossible.

SPASTIC HEMIPLEGIA WITH SPONTANEOUS RECOVERY.

DR. KILIANI presented a girl, three years old, who was admitted to the German Hospital on June 30, 1911, with the

history of having been shot in the back with a 42-calibre revolver bullet. The wound of entrance was found in the lumbar region, half an inch to the right of the median line and extending upward and to the left in an oblique direction.

The history obtained was that after receipt of the injury, the child's left side was completely paralyzed. When Dr. Kiliani first saw her, in August, 1911, the only symptoms that remained indicated a partial paralysis of the muscles of the left lower extremity. The leg was flexed and abducted. The patient was now able to raise her foot a few inches from the bed.

EXTREME RECTAL PROLAPSE CURED BY OPERATION.

Dr. Frederic Kammerer reported the case of a woman, 29 years old, upon whom he had operated for a very large rectal prolapse a year and a half ago. The patient had been under his care for over six months, but he had been unable to trace her lately and could not, therefore, speak definitely of her condition to-day.

In the course of her treatment, various plastic operations had been done on the perineum and in the sacral region, the last one being a colopexy, with partial denudation of the left iliac fossa and suture of the sigmoid to the area stripped of its peritoneal covering (denormant), a procedure which had apparently given permanent results in several other cases. In this case, however, six weeks after operation, the patient had a fall while still in the hospital, resulting in a renewed prolapse of the entire rectum. The speaker now resorted to the method described by Quenu and Vidal of obliterating the cul-de-sac by two purse-string sutures, and suturing the bowel to the posterior surface of the broad ligament and the left iliac fossa. As an additional safeguard, he had fastened the uterus to the anterior abdominal wall, which procedure, he believed, was not included in the method of Quenu and Vidal. There had been no recurrence during the period of observation mentioned above.

Dr. A. V. Moschcowitz said that very recently one of the house surgeons of Mt. Sinai Hospital had called his attention to the operation of Quenu and Vidal for prolapse of the rectum, a description of which was published in the *Revue de chirurgie.*

Dr. Moschcowitz said that through the courtesy of several members of the Society he had been fortunate in seeing a goodly

number of cases of prolapse of the rectum during the past four or five years. In his earlier cases he did the operation from below, dividing the sacrum and getting at the prolapse by that route. This method was not always satisfactory, and during the past four years he had practically followed the method by Quenu and Vidal, closing up the cul-de-sac of Douglas. In women, he first separated the peritoneum, which gave a far better result than by merely closing the cul-de-sac, and in some of these cases he also added a fixation of the uterus high up.

Dr. Moschcowitz in conclusion said, that he had not as yet read the article in question, and on that account did not wish to enter into a discussion of priority; but he would like to mention at this time that his first case was done nearly four years ago.

DUODENAL ULCER.

Dr. Kammerer presented a man, 33 years old, who had developed all the classical symptoms of stenosis of the pylorus. At the operation, the first portion of the duodenum was found firmly bound down by adhesions, posteriorly, with a stellate cicatrix on the anterior surface, about half an inch from the pylorus. A posterior gastro-enterostomy, done six months ago, had relieved all his symptoms.

Dr. Kammerer also presented a man, 25 years old, who had had a history of eight years' duration, pointing to an ulcer in the duodenum. In this case there were no symptoms of stenosis at the outlet of the stomach. The patient had finally drifted into a state of chronic invalidism, with great emaciation. At the operation, which was done not quite a year ago, an indurated area on the anterior surface of the first portion of the duodenum was found. There were no adhesions. A posterior gastro-enterostomy, followed by a unilateral exclusion of the pylorus, was done. The latter was accomplished by section of the stomach, about an inch and a half from the pylorus, with closure of both ends (Von Eiselsberg).

The patient had gained forty pounds in weight since the operation, and was free from all symptoms. The speaker thought this exclusion, whenever practicable, was preferable to simple infolding of the ulcer by sutures. Where there was no stenosis, some form of closure of the pylorus ought to be practised.

DIVERTICULUM OF THE GALL-BLADDER.

DR. KAMMERER showed a woman of 48 years, who came to the hospital with a well-marked recurring cholecystitis. The operation revealed a rather unusual condition. On opening the abdomen, extensive adhesions were found to the enlarged and very much thickened gall-bladder. After liberating the body of the gall-bladder, a hard, irregular, spherical mass, an inch and a half in diameter, could be felt, resting against the cystic duct on the one side, and firmly adherent to several coils of small intestine on the other. It gave the impression of an enormous gall-stone in migration from the gall-bladder to the intestine. With considerable difficulty the intestines were separated from the mass, a ligature passed around the cystic duct, and the gall-bladder removed with the mass *in situ*. The latter consisted of a shell of calcareous matter, from one-sixteenth to one-eighth of an inch in thickness, with a fairly smooth inner surface, which on microscopic examination proved to be a lining of mucous membrane, the interior being completely filled with a substance of waxy consistency, uniformly tinged with bile. There was, however, no communication between this cavity and that of the gall-bladder proper, at least not at the time of operation, nor could any indication of a previous communication be found.

RESECTION OF THE ŒSOPHAGUS AND LARYNX FOR CARCINOMA.

DR. KAMMERER presented a man, 45 years old, who had been suffering from increasing difficulty in deglutition until he was scarcely able to swallow anything, solid or liquid, and was in a condition of marked emaciation. The stomach tube was arrested at a point corresponding to the cricoid cartilage, and a distinct mass could be felt by external palpation of the neck.

A preliminary gastrostomy was done, and two weeks later, through an incision along the anterior border of the left sterno-mastoid muscle, the constricting mass in the œsophagus was exposed. In the course of the operation, the entire laryngo-pharynx and about two inches of the œsophagus proper, the entire larynx, and the left half of the thyroid gland had to be removed. The stump of the trachea was sutured to the skin above the sternum, the pharynx above, the œsophagus below were closed by sutures, and the prevertebral wound cavity was partially tamponed with gauze. The patient bore the operation well,

and was now, six months later, in a much improved general condition.

DR. WILLY MEYER showed a series of cases illustrating the end results of various operations after the lapse of from three and a half to ten years.

PERICARDIOTOMY.

The patient was a man, 34 years old, who had been operated on at the German Hospital three and a half years ago. Upon admission to the hospital, the patient was suffering from intense dyspnœa, cough, night-sweats, and œdema of legs. A diagnosis was made by Dr. J. Kaufman of effusion into the pericardium. This was aspirated by Dr. Meyer, and about a quart and a half of dark-colored fluid was withdrawn. This procedure gave only temporary relief, and a week later he was again tapped, and about a quart of fluid evacuated. The relief again was only temporary, and six days later, under local anæsthesia, the sixth and seventh costal cartilages were resected, the pericardium was incised, and over two quarts of fluid evacuated. The heart itself could not be seen until a large number of black coagula were removed. After this there was immediate improvement in the patient's symptoms. Convalescence took nearly five months. The case was considered to have been one of tuberculous pericarditis, and the patient was sent to Liberty, N. Y., where he had remained ever since, and where his health had become entirely restored. (See ANNALS OF SURGERY, 1909, vol. xlix, p. 261.)

IMPLANTATION OF SILVER FILIGREE FOR INTRACTABLE ABDOMINAL HERNIA.

The patient was a woman, now 53 years old, upon whom the operation had been done ten years ago, and who had already been shown at one of the previous meetings of the Society. The history dated back twenty years, when at some other hospital the patient had her uterus removed, and the resulting wound was drained with gauze. Following this, a large ventral hernia resulted. She also had a diastasis of the recti above the umbilicus. She was subsequently operated on by Dr. F. Lange, who buried silver wire and silkworm gut sutures, and she remained well about a year and a half.

The patient first came under Dr. Meyer's observation eleven years ago, with a large abdominal hernia, the aperture being between the umbilicus and symphysis; it was too large to be closed by autoplasty; therefore the omentum was pulled down and stitched to the borders of the defect. An abdominal bandage gave sufficient support to enable the patient to attend to her work as cook. About one year later, during an attack of acute intestinal catarrh, a severe vomiting spell tore the omentum loose and the hernia returned. A few months later Dr. Meyer implanted a silver wire filigree imported from Germany. It healed in nicely after a sinus resulting from a fascia necrosis had closed under treatment with pure carbolic acid. The patient seemed entirely cured and could be discharged without a truss in spite of her large pendulous abdomen. Nine months later, on turning suddenly, she knocked this very spot against the corner of a kitchen sink and almost fainted. Examination and subsequent operation showed that the filigree had been broken in its centre but that otherwise it was properly in place. An additional filigree was made during the operation which permanently cured the trouble. She now has been wearing these filigrees for ten years; she has never worn an abdominal supporter and the hernia has never returned. Recently, Dr. Meyer operated for the diastasis of the recti above the umbilicus which had returned in spite of a second operation done by another surgeon. The muscles were separated almost up to the xiphoid process and could not be brought together, and he made a typical filigree with cable silver wire in course of the operation. This hernia, too, seems to be definitely cured.

Dr. Meyer stated that he had done quite a number of operations for defects of the abdominal wall as well as for intractable herniæ by means of silver wire implantation. He emphasized the advantages of the cable silver wire over the German wire. The former is very flexible and does not break so easily. Temporary sinuses, he stated, are best treated with suction cups.

RESECTION OF THE ASCENDING AND TRANSVERSE COLON FOR CARCINOMA.

Dr. Meyer showed this patient, upon whom the operation had been done in November, 1905, six years ago. The patient was a woman, then 57 years old, who had been treated for a long time for cholecystitis, and who had suffered for years from pain

in the region of the hepatic flexure. The diagnosis of cancer of the colon was made. Incision through the right rectus showed a large, infiltrating carcinoma, involving the ascending and part of the transverse colon; ileocolostomy was done with the elastic ligature, and the abdomen closed. Five weeks later, median incision; resection of the tumor and inversion of the divided gut on either side of the well functionating anastomosis. She made an uninterrupted recovery, gained rapidly in weight, and, as far as the colon is concerned, has been well ever since. In November, 1908, the speaker had to remove a tumor of the bladder of this patient, which proved to be carcinoma. Bladder and abdomen were closed by layer sutures and a permanent catheter was placed in the urethra. The patient was discharged at the end of two weeks and is to-day in perfect health.

SPLENECTOMY FOR SPLENIC ANÆMIA.

This patient was a man, 41 years old, whose spleen had been removed three and a half years ago. He had been extremely low, and direct transfusion was done by the house surgeon, Dr. Ottenberg, in January, 1908. The effect, though favorable at first, was not lasting. In March of the same year splenectomy became necessary, and was done with the help of osteoplastic resection of the costal arch. The tail of the pancreas (about one-third of the organ) had to be excised with the spleen. The patient made a perfect recovery; and has remained in good health since, being able to attend to his work.

This observation again proves that splenic anæmia is a surgical disease curable by operation. (See ANNALS OF SURGERY, 1909, vol. xlix, p. 258.)

CRANIOTOMY FOR FIBROSARCOMA OF THE AUDITORY NERVE.

The patient was a woman, 23 years old, who was operated on over three and three-quarters years ago, in January, 1908 (ANNALS OF SURGERY, 1908, p. 309, and 1909, vol. xlix, p. 552). She had shown all the typical signs of brain tumor, and had been almost blind, as pointed out at one of the previous meetings. The operation was done in one sitting; a large horseshoe shaped skin muscle flap, which later on had to be divided in the middle, was turned down, thus exposing the occiput. The entire occipital bone was removed, the longitudinal sinus doubly ligated and

divided, and the dura mater opened by a heart-shaped incision, the flap being turned down. The cerebellum, thus made movable, was held aside by the brain elevatorium, when in the depth the bluish-gray tumor came nicely into view. It was shelled out with Kocher's "Kropfsonde"; the wound was carefully drained. The dura mater flap could not be brought into apposition again with the upper border on account of the bulging brain, but the skin muscle flap was sutured in place. The patient made a perfect recovery. To-day she shows the signs of a typical decompression operation and wears a leather-covered aluminum plate for protection. She is able to walk alone on the street for long distances, can read and write and do embroidery work, and makes herself generally useful in the household. There is no sign of a recurrence.

PARTIAL GASTRECTOMY FOR CARCINOMA IN A PATIENT 24 YEARS OLD.

The patient was a man, who had entered the hospital greatly emaciated with typical signs of pyloric obstruction; stomach analysis did not point to carcinoma. On opening the abdomen, a large infiltrating tumor was found at the pylorus and many glands alongside the larger curvature; none at the lesser one, near the pylorus, but further away up toward the cardia; it was most difficult to remove the latter. Typical resection of stomach was done and posterior gastro-enterostomy with the button added. Recovery was uneventful. To-day the patient is in perfect condition, having gained considerably in weight.

In connection with this, Dr. Meyer mentioned another case which showed the necessity of resection of the ulcer-bearing area of the stomach whenever possible. He referred to a man at present in the hospital, in whom he had done gastro-enterostomy for pyloric obstruction two years ago. One gland was found in the major omentum on which the laboratory, after a few minutes, reported "no carcinoma." On basis of this, anastomosis was done. At present he is again in the hospital with an inoperable pyloric carcinoma.

SIMULTANEOUS REMOVAL OF RENAL AND URETERAL CALCULUS ON THE SAME SIDE.

The patient, 39 years of age, had had litholapaxy done twice and showed stone in the kidney as early as seven years ago, but

refused operation. This summer he again came under observation, with an immense, ramified stone in each kidney. On the left side there was in addition a ureteral stone. Dr. Meyer proposed an operation in two sittings on the latter side, as he considered it safer to first arrange for proper drainage of the kidney and then to operate on the latter. However, patient having no time to lose, insisted on a simultaneous operation. Consequently, after resection of the twelfth rib, the kidney was brought into view, pelviotomy was done, and the lower end of the stone broken off, on purpose. Then the section cut was added and the other ramified portion removed; finally, two smaller, separate stones were cut out of the parenchyma. There was no suppuration at all; the kidney tissue tightly embracing the calculus, it could be gently stripped off without much injury. The pelvis was sutured as well as either pole of the kidney, and the centre of the section cut drained; after proper dressing, the patient was turned around and extraperitoneal left ureterotomy added. The stone was found near the bladder (as the X-rays had demonstrated); after proper incision, it could be well developed; the ureter was then sutured. The patient made a good recovery, left the hospital in about three weeks and wants to wait—against advice—for the removal of the right renal calculus until next spring.

Here again the needle holder, the so-called "Küster's swan," as improved by the author and published in the ANNALS OF SURGERY, July, 1910, in a paper on thoracic surgery, proved of greatest advantage. Although, as it has been pointed out in an article by Wm. J. Mayo recently, that the ureteral wound can be left open in such cases, his patients having made good recoveries, it nevertheless seemed advisable to the speaker to close it. He stated that so far he had been able to close every ureteral wound of this kind, even in the closest proximity to the bladder. High Trendelenburg's posture and this needle holder allow the work to be done.

TRANSDUODENAL CHOLEDOCHOTOMY.

This patient, 25 years old, was operated upon in June, this year. She had had many attacks of biliary colic and became jaundiced early in May. Operation June 29: Rectus incision; cholecystostomy; stones removed; choledochotomy; removal of stones; one calculus low down could not be pushed up into the

wound in the common duct; duodenal incision. A stone was found tightly wedged in the papilla Vateri, half in the duct, half in the duodenum; duct incised; stone removed. A probe introduced through the choledochotomy wound showed patency of the duct; double layer suture of the duodenum; suture of the common duct; drainage of the gall-bladder. Patient made a good recovery and is to-day in perfect health.

THORACOTOMY FOR IMPERMEABLE CARDIOSPASM (TWO CASES) WITH REMARKS ON DRAINAGE AFTER INTRATHORACIC OPERATIONS.

Dr. Willy Meyer stated that a few months ago he had published in the *Jour. of the Am. Med. Ass'n,* a case of impermeable cardiospasm in a woman, 47 years old. She had a very large pouch above the diaphragm. Thoracotomy was done under differential pressure; both pneumogastric nerves were widely separated from the œsophagus and the latter's pouch reduced in size by a double plication. She made a perfect recovery and was shown before this Society last fall, having gained quite some weight. An interesting point in her history was that she had regained the power of swallowing solid as well as liquid food *without any further intervention.* Seven months later she went through a severe attack of influenza-pneumonia, and not long thereafter developed a thoracic œsophageal fistula, evidently due to one or more sutures having cut through the œsophageal wall. Silk had been used. She refused further operation on the thorax and died a year after the first operation, having retained the ability of swallowing up to the last. Postmortem showed the signs of a posterior suppurative mediastinitis.

Dr. Meyer now presented two further cases of the same kind. In both thoracotomy and single plication had been done with chromicized catgut. The first patient whose cardia had been frequently stretched by competent men, without gratifying results, was to-day well able to swallow his food, only that in the beginning of his meals he had to take a swallow of water and force the food down with the help of intrathoracic pressure.

In the second case, Dr. Einhorn had diagnosed an organic stricture at the cardia, probably due to a former ulcer, but inasmuch as during the operation the sound passed the cardia, although with some difficulty, a plasty was not done on the

cardia, but the operation as mentioned before. Patient made an uninterrupted recovery, but, functionally, he has not been much improved; he is able to swallow liquids, but no solids. It is the speaker's intention, now to first try stretching of the cardia and, if this should prove of no avail, to do a second thoracotomy and perform intrathoracic cardioplasty according to the v. Heinecke-Miculicz method of pyloroplasty.

Dr. Meyer stated that in almost every one of his operations on the œsophagus he observed that a cardia which is not occupied by a tumor could be easily pulled far into the thoracic cavity. He could see no reason why cardioplasty should not be done through the thorax. It certainly must be easier than to turn up the costal arch and work from the side of the abdomen, as Wendel has done.

In both of the last cases and an additional third one before, all three having been operated upon in the negative chamber in the course of May and June this year, Dr. Meyer tried a new method of thoracic drainage which he planned two years ago, at the time of preparing for the building of the new Thoracic Pavilion of the German Hospital. The same consists in closing the original thoracic incision and making another intercostal one in the complementary space for drainage with ordinary rubber drainage tubes. Thus proper exit is provided for the immediate secretion of the pleura as well as any air that may bubble out from a sutured lung wound, as for instance, after an accident. The compression of the lungs by fluid or air, with its possibly fatal consequences, may thus be avoided. Post-operative acute pneumothorax is prevented by continuing the patients under differential pressure for some time after operation, instead of sending them back to the ward. The head rests within the cabinet, where it can be easily reached by doctors and nurses who serve in relays, as the air lock permits of entrance and exit. The patient's body rests comfortably on a bed without head piece, of same height as the operating table. All kinds of stimulation, as rectoclyses and hypodermoclyses, intravenous infusions and hypodermic injections, can be given outside, and, of course, food can be brought to the patient. After having been removed from the apparatus, the patient is kept for about 24 hours in one of the two recovery rooms provided for, which are rather observation rooms, in order to determine whether a reapplication of differential pressure is required.

It is self-understood, that in aseptic cases the thoracic incision is closed without drainage.

Dr. Meyer then demonstrated Tiegel's thoracic metal-drainage tube, as published in the *Centralblatt f. Chir.*, early this year, which he had lately imported. He also mentioned the method of Robinson for the treatment of empyema, who perforates the rib and screws in a snugly fitting trocar cannula, siphon or suction drainage then being established. It is evident, that this procedure can also be used for drainage after intrathoracic operations.

He further referred to the proposition of Green and Janeway, who lately have come forward with a plan of thoracic drainage in experimental surgery, similar to that of his own.

He pointed out, that in the method advocated by himself, the after-treatment of the thoracic wound does not differ from any other wound treatment. He believes that it can be employed with any kind of differential pressure apparatus—provided its use does not require general anæsthesia—inasmuch as his observations so far have shown that a continuation of differential pressure for 12 to 15 hours after the operation suffices to form adhesions between pulmonal and costal pleuræ, strong enough as to permit of the patient's removal from the apparatus.

The manner in which the drainage after intrathoracic operations at the German Hospital is done was then demonstrated during a walk through the new pavilion for thoracic surgery.

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